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THE WINTERING WADER AND WILDFOWL POPULATIONS OF STRANGFORD LOUGH

A report by the
British Trust for Ornithology
to the
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by

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ABSTRACT

1. The patterns of distribution and abundance of waders and wildfowl using Strangford Lough during the non-breeding season were analysed from coordinated counts made during the period 1965 to 1988.

2. Strangford Lough qualifies as a wetland of international importance, according to Ramsar criteria, with more than 20,000 wildfowl and 40,000 waders in winter. There are also internationally important concentrations of Light-bellied Brent Goose, Knot and Redshank.

3. At least 1% of the UK population of a further 17 species occur on the lough in autumn or winter. These species are Mute Swan Whooper Swan, Shelduck, Gadwall, Shoveler, Goldeneye, Red-breasted Merganser, Oystercatcher, Ringed Plover, Golden Plover, Lapwing, Dunlin, Bar-tailed Godwit, Black-tailed Godwit, Curlew, Greenshank and Turnstone.

4. Most species selected for detailed appraisal show long-term population trends similar to the trends in flyway (wildfowl) and UK (wader) indices. Dunlin have increased at Strangford Lough in contrast with declines in the UK indices. Numbers of Wigeon and Whooper Swan have declined substantially, although flyway indices have remained relatively stable for Wigeon.

5. Within Strangford Lough, the northern mudflats form the most important section, particularly for waders and the grazing wildfowl. The western shore, notably Ardmillan and Ringneill Bays and the mid-lough islands, with its finer muds and sheltered bays, is next in importance. Species preferences and sequential use of sections of the lough are interpreted.

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1. INTRODUCTION AND AIMS

Strangford Lough (Figure 1) is a sea lough on the east coast of Northern Ireland, oriented from northwest to southeast with an opening into the Irish Sea. The landscape has many glacial features, and is a prime example of a drumlin field, producing a topography of gently rounded hills around the lough. The many islands are also drumlins, with raised beaches; those islands off the sheltered western shore being well-developed and shielding muddy bays. The islands along the north-eastern shore are eroded by exposure to the predominantly southwesterly airstream and so tend to be low, small, islets. Islands in the southeast sector of the lough are composed of bedrock.

The main substrate features can be assigned to six categories (Figure 1):-

1. Fine mud sediments are located, principally, in the sheltered bays of the western shore and the southwest corner.
2. Boulders and well-developed drumlin islands shelter these muddy bays.
3. Muddy sand at the northern end of the lough forms extensive, open, tidal flats.
4. The eastern shore is characterised by small areas of muddy substrate, strewn with boulders.
5. Bedrock is the dominant substrate in the Narrows.
6. Stony substrates occur in small pockets around the lough.

The National Trust for Northern Ireland owns, or has management agreements or shooting rights over much of the foreshore. The Strangford Lough Wildlife Scheme was established in 1965. A management plan was drawn up for the area, incorporating policies for managing habitats for their intrinsic wildlife value and for recreational and occupational uses, such as cockle fisheries. Other reports contributing to the Review will deal with various topics incorporated in the plan.

The need for this Review of the Strangford Lough Wildlife Scheme was triggered by the apparent declines in certain species of wildfowl and waders on the lough. These declines were investigated and recommendations were made for monitoring and research.

The aims of this report are:-

1. To assess the relative importance of Strangford Lough for wintering wildfowl and waders, in terms of regional, all-Ireland, UK and international significance.

2. To explain the role of Strangford Lough in the annual cycle of selected species by identifying seasonal and long-term trends in numbers and relating these to published information about origins and migrations.

3. To identify distributions and sequential use of sites within Strangford Lough in order to determine which areas are of particular importance to selected species of wildfowl and waders in winter.

2. METHODS

Field Methods

Monthly counts, for the period September to March, have been made since 1965, the year before the inception of the Strangford Lough Wildlife Scheme. Counts were carried out during the two to three hours before high water, i.e. on a rising tide.

There have been some changes to counting sections for the lough over the 24 years (Figure 2), but few changes involved incomplete overlap of adjacent counting sections. Consequently, with some merging, comparisons can be made of old and new sections. Since 1982, there have been 62 counting sections in use, the longest being approximately 5 km of shoreline.

Each section is counted by one person, but some counters census more than one section. Inevitably, this may lead to counters being overstretched to cover the ground adequately. In particular, use of inland sites bordering the lough may well have been under-recorded and less conspicuous species missed as a result. Owing to the large area covered by Strangford Lough, the timing of high water varies by 1.5 hours from one end of the lough to the other. Consequently, in order to ensure that counts are carried out at the state of tide best suited to accurate counting, the timing of counts differs across the lough. This may lead to duplication or omission of birds moving between count zones.

It is considered that count coverage has been very good at Strangford Lough. The constraints of site-size and availability of a committed team of counters seem to have been largely overcome, although counts from the early years of the scheme seem to be very low for most species.

A boat is used to enable the islands and surrounding intertidal areas to be censused.

Analyses

The wildfowl and wader counts which form the basis of this report, were started in 1965, as part of the Strangford Lough Wildlife Scheme, and contribute to the Birds of Estuaries Enquiry (BoEE) of the British Trust for Ornithology and the National Wildfowl Counts of the Wildfowl and Wetlands Trust. The data set consulted for this report covers the period 1965 to 1988. The counts were computerised in autumn 1989 in order to make them available for the review process. There are few missing values in this large data set; 1966/67 is incomplete and the data for Brent Goose in 1969/70 are missing.

The UK and international importance of Strangford Lough

Summaries of the last five years' (1984/5 to 1988/9) data were compiled. January and average peak winter counts, based on September to March for wildfowl and on November to March for waders, were compared with population estimates for the relevant flyway population, the UK, all-Ireland and Northern Ireland (Appendix I).

Total counts for Strangford Lough were obtained by summing counts for each section in each month, for each species.

Estimates of the Northern Ireland populations of waterfowl are the higher of the average winter counts, derived from tables for Northern Ireland in Salmon et al. (1987a & b, 1988 & 1989), and the estimates for waders given in Moser & Prys-Jones (1988). The higher value was taken to compensate for incomplete coverage in most years.

UK population estimates were then produced by combining the calculated Northern Ireland values with values for Great Britain from Moser (1987) for waders and Salmon et al. (1989) for wildfowl.

Population estimates for all-Ireland were supplied by Ralph Sheppard (unpublished).

Flyway population estimates were obtained from Smit & Piersma (1989) for waders and Pirot et al. (1989) for wildfowl.

The importance of Strangford Lough as a wetland site was determined from the criteria which are used for identifying sites of international importance under the Ramsar Convention (Owen et al. 1986). A wetland is considered to be internationally important if it regularly holds at least 1% of the estimated flyway population of one or more species of waterfowl or at least 20,000 waterfowl in total.

As a result of establishing the species for which Strangford Lough is of conservation importance in international and UK terms, 20 key species of waders and wildfowl were selected for further consideration. Selection was based principally on Ramsar criteria, but consideration was also given to encompassing a variety of feeding strategies and behavioural patterns, e.g. dabbling and diving ducks are represented. Also, a combination of quarry and non-quarry species was sought.

Species accounts contain information on the following:-

1. Origins, migration and seasonal patterns patterns of abundance

A review of the published literature provided information on the origins and migrations of selected waterfowl species.

Using count data for the five years 1984/85 to 1988/89, histograms were plotted of monthly totals on Strangford Lough for each species. These were interpreted in terms of known migration strategies and origins.

2. Distribution within Strangford Lough

Initially, the lough was divided into five sections; the northern shore, the western shore, the southern shore, the eastern shore and the Narrows. This coarse division was based on broad habitat and geographical features (Figure 1) and count zones (Figure 2). For each sector, seasonal patterns of abundance were plotted, on a

map of Strangford Lough, for each selected species, using five year averages for 1984/85 to 1988/89. Sequential occupation of sites and site preference were determined. The assumption is that preferred sites are occupied first, a feature recognised in studies elsewhere, e.g. for Knot at the Wash (Goss-Custard 1977), Oystercatcher (Goss-Custard 1982) and Grey Plover (Moser 1988). Further subdivision of those sectors of the lough which held most birds was carried out to provide a finer resolution of site preference for a subset of species.

3. Long-term trends in numbers

Using the complete run of 24 years' count data, correlation coefficients were calculated for January versus peak winter counts (Table 1). January and peak winter counts were plotted alongside flyway trends for wildfowl species and UK trends for wader species. The use of different comparative measures (i.e. flyway for wildfowl and UK for waders) was dictated by availability. The long-term changes in numbers of waterfowl species on Strangford Lough were related to changes in populations for the flyway or the UK.

3. RESULTS

3.1. THE CONSERVATION STATUS OF STRANGFORD LOUGH

Correlations between peak winter counts and January counts were poor for most species of waterfowl (Table 1). Average peak winter counts (Table 2) for the 5 years from 1984/85 to 1988/89 are presented alongside proportions of estimated populations for the flyway, UK, all-Ireland and Northern Ireland. Average peak winter counts have been used because they give a more representative picture of the importance of a wetland for the whole winter than January counts can. Since most wetland site assessment is based on January counts, these are presented for comparison (Appendix II).

Table 1 Correlation Coefficients (r) for January v. Peak Winter counts for several species of waterfowl, for the 24 year set of data from Strangford Lough.

Species	r	Species	r
Mute Swan	0.28	Oystercatcher	0.44
Brent Goose	0.28	Golden Plover	0.09
Shelduck	0.79	Lapwing	0.13
Wigeon	0.37	Knot	0.81
Gadwall	0.93	Dunlin	0.18
Teal	0.76	Black-tailed Godwit	0.58
Mallard	0.32	Bar-tailed Godwit	0.45
Shoveler	0.17	Curlew	0.45
Goldeneye	0.29	Redshank	0.83

The criteria, relating to waterfowl, for international importance of a wetland site, drawn up at the Ramsar Convention on Wetlands

of International Importance (Owen et al. 1986) and recognised by 52 countries, are as follows:-

1. At least 1% of the estimated flyway population of a species of waterfowl must occur regularly.
2. The site must hold over 20,000 waterfowl species on a regular basis (Salmon et al. 1989).

The lough qualifies as a wetland of international importance in terms of total counts of waterfowl in winter (Table 2) and autumn. There are over 74,000 waterfowl regularly wintering at Strangford Lough (Salmon et al. 1989).

In addition, Strangford Lough has internationally important populations , according to Ramsar criteria, of Light-bellied Brent Goose (Branta bernicla hrota), Knot (Calidris canutus) and Redshank (Tringa totanus).

Also, numbers of the following species wintering on Strangford Lough meet, or exceed, the 1% criterion for the UK: Mute Swan, Whooper Swan, Shelduck, Gadwall, Shoveler, Goldeneye, Red-breasted Merganser, Oystercatcher, Ringed Plover, Golden Plover, Lapwing, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Greenshank and Turnstone.

Strangford Lough is the most important site for waders in terms of total numbers, and ranks third in all-Ireland for its total numbers of wildfowl.

There are also mid-winter peaks of Great-crested Grebe, Little Grebe, and Scaup. White-fronted Goose, Pinkfooted Goose and Bewick Swan occur at Strangford Lough as occasional mid-winter visitors. The populations of Canada Goose, Barnacle Goose and Greylag Goose are feral ones.

In autumn, numbers of Coot, Little Grebe, Great-crested Grebe and Greenshank are usually at their highest. Greenshank also occur in low numbers on spring passage. Strangford Lough is a staging post of international importance, with over 20,000 wildfowl and waders present in autumn.

In the absence of population indices for all-Ireland, it was not possible to assess the relative importance of Strangford Lough in the Irish context. However, most species shown on Table 2 occur in excess of 1% of the all-Ireland population estimates (Sheppard - unpublished) and it can be assumed that the importance of Strangford Lough, in the Irish context, will be confirmed, once such indices are available.

Table 2 THE STATUS OF STRANGFORD LOUGH FOR WINTERING WILDFOWL AND WADERS, BASED ON AVERAGE PEAK WINTER COUNTS (1984/85 TO 1988/89), IN THE CONTEXT OF NORTHERN IRELAND, ALL-IRELAND, UK AND FLYWAY POPULATIONS

Species	Av pk winter count	% N.Irl[1] popn.	% all[2] Irl popn.	% UK[3] popn.	% Flyway[4] popn.
Great crested Gr	63	3.5	-	*	-
Little Grebe	109	-	-	-	-
Mute Swan	214	12.7	3.0	1.1	*
Whooper Swan	91	3.4	*	1.0	*
Greylag Goose	417	52.1	11.0	*	*
Barnacle Goose	54	-	-	-	-
Brent Goose	13,455	89.1	67.3	67.3	67.3
Canada Goose	167	52.2	-	-	-
Shelduck	2,186	66.6	17.5	2.9	*
Wigeon	1,888	10.6	-	*	*
Gadwall	92	51.1	20.4	1.8	*
Teal	985	19.3	2.0	*	*
Mallard	1,759	20.2	*	*	*
Pintail	221	73.7	11.0	*	*
Shoveler	131	46.8	3.1	1.4	*
Pochard	303	1.2	1.0	*	*
Tufted Duck	317	2.3	1.6	*	*
Scaup	29	1.5	1.1	*	*
Goldeneye	409	4.0	4.0	1.6	*
Red-breasted Merg	283	39.3	9.4	2.8	*
Coot	692	12.9	2.3	*	*
All wildfowl	**25,111**				
Oystercatcher	4,587	29.8	6.6	1.5	*
Ringed Plover	228	20.4	2.3	*	*
Golden Plover	9,082	94.6	9.1	4.5	-
Grey Plover	184	+	4.6	*	*
Lapwing	13,883	58.3	6.9	1.4	-
Knot	9,824	+	39.3	4.5	1.9
Dunlin	5,704	46.7	5.7	1.3	*
Common Snipe	91	+	-	-	-
Blk-tailed Godwit	172	+	2.1	3.4	*
Bar-tailed Godwit	1,057	35.2	4.6	1.7	*
Curlew	1,682	25.6	1.7	1.7	*
Redshank	3,100	45.1	12.4	3.8	2.8
Greenshank	38	36.0	7.6	13.0	*
Turnstone	428	14.6	4.3	*	*
All waders	**49,028**				
All waterfowl	**74,139**				

* proportion less than, or equal to, 0.01%
\- no estimate available
\+ population size likely to be an underestimate

1 Salmon et al. 1987 a & b, 1988, 1989; Moser & Prys-Jones 1988
2 Sheppard (unpublished)
3 Moser 1987; Salmon et al. 1989, plus references quoted at 1.
4 Pirot et al. 1989; Smit & Piersma 1989

3.2. SPECIES ACCOUNTS

The following species accounts incorporate information on origins, migrations, seasonal abundance and long-term population trends at Strangford Lough, and within-lough distribution for each of the selected species. The relevant Flyway indices for Mute Swan, Whooper Swan and Brent Goose from the Irish wintering population were not available for the Review.

For long-term population trends, both average peak winter and January counts were plotted because of the predominantly poor correlations (Table 1) between them and the present use of January counts to calculate population indices. Revised indices will be based on recommendations for the calculation of population indices given by Underhill (Underhill 1989) and were not available for this Review.

3.2.1 Mute Swan *Cygnus olor*

Average peak midwinter count - 214
All-Ireland population estimate - 7,000
UK population estimate - 20,000
Flyway population estimate - 25,000

Origins, migration and seasonal abundance

Mute Swans have a patchy but widespread breeding distribution throughout the temperate Palearctic (Monval & Pirot 1989). The Mute Swans in Britain and Ireland are mainly resident and number, approximately, 25,000 (Salmon *et al.* 1989; Sheppard - unpublished). However, population estimates are likely to be low for such a widely dispersed species. There is some immigration, mainly from western Scotland (Hutchinson 1989), in winter to supplement numbers of Irish breeding birds.

Numbers of Mute Swans at Strangford Lough peak, consistently, in autumn, declining gradually thereafter to their lowest levels in February/March (Figure 3.2.1a). It is not known where these birds

move to, but their decreasing numbers on the lough probably represents general dispersal to smaller water bodies. In 1985/86, numbers were higher than in other years for every month.

Distribution within Strangford Lough

Sections 2, the west shore, and 1, the north shore, are used most (Figure 3.2.1b), with section 2 continuing to have most Mute Swans throughout the winter. Sections 4 and 5 have few birds at any time in the winter.

Long-term population trends

Low counts in the late 1960s preceded a period of sustained higher counts until the 1980s, during which there has been a steady decline (Figure 3.2.1c & d). This decline at Strangford Lough is part of a decline throughout the UK. In Britain, the decrease is attributed largely to the use of lead weights by anglers causing lead poisoning (Monval & Pirot 1989). However, reasons for the decline at Strangford Lough are not clear. Peak winter and January counts show similar trends.

3.2.2 Whooper Swan Cygnus cygnus

Average peak winter count	- 91
All-Ireland population estimate	- 10,500
UK population estimate	- 9,000
Flyway population estimate	- 17,000

Origins, migration and seasonal abundance

Whooper Swans which overwinter at Strangford Lough come from Icelandic breeding grounds (Hutchinson 1989). The first migrants arrive in September/October; most are thought to make a direct flight from Iceland. Peak numbers occur at Strangford Lough in November/December (Figure 3.2.2a). Birds depart in March/April.

Long-term population trends

Overall, there has been a decline in the numbers of Whooper Swans visiting Strangford Lough in winter since the late 1970s (Figure 3.2.2c & d).

3.2.3 Brent Goose (light-bellied) *Branta bernicla hrota*

Average peak winter count	- 13,455
All-Ireland population estimate	- 20,000
UK population estimate	- 20,000
Flyway population estimate	- 20,000

Origins, migration and seasonal abundance

The Brent Geese which overwinter in Ireland originate from breeding grounds in northern Greenland and eastern Canada (Owen *et al*. 1986; Prater 1981), notably on Queen Elizabeth Islands and Bathurst Island (O'Briain). Iceland is the main staging post, but there are regular occurrences along the west coast of Scotland during migration, especially in autumn. Most birds arrive at Strangford Lough in autumn and many overwinter, although there is some dispersal to other sites during winter (Hutchinson 1989).

Peak numbers occur in October/November, before a sharp decrease from November/December onwards (Figure 3.2.3a). In 1988/89 peak numbers were the lowest of any of the five years, but winter 1989/90 shows an increase again, so reduced numbers in the winter of 1988/89 represented a temporary decline. The patterns of abundance of this species are discussed in more detail in Fox *et al*. 1990.

Distribution within Strangford Lough

Section 1 is by far the most important, numerically, for Brent Geese and is occupied first (Figure 3.2.3bi). Peak numbers are present in October. Within the northern section of the lough, count zones E70 to F30 (Figures 2 & 3.2.3bii) inclusive hold the most Brent Geese. The remaining sections are little-used but

geese spread out and occur in smaller concentrations as the winter progresses. Further details of these patterns are presented by Fox et al. (1990).

Long-term population trends

January counts have shown considerable fluctuation, but the overall trend has been upwards since the start of the Strangford Lough Wildlife Scheme (Figure 3.2.3d). Peak winter counts rose in the late 1960s to a peak in 1970 (Figure 2.3.3c). Thereafter, apart from the winters of 1974/75, 1982/83 and 1988/89, when numbers dropped markedly, Brent Goose numbers have remained stable or, possibly, increased slightly. See Fox et al. 1990.

3.2.4 Shelduck Tadorna tadorna

Average peak winter count	-	2,186
All-Ireland population estimate	-	12,500
UK population estimate	-	80,000
Flyway population estimate	-	250,000

Origins, migration and seasonal abundance

The majority of Shelduck wintering in Ireland are residents, but these are augmented by some migrants from other North Sea countries, including Norway (Hutchinson 1989; Prater 1981). There is an annual post-nuptial moult migration to Heligoland, in the German Wadden Sea, but moulting flocks occur also at Bridgewater Bay on the Severn estuary, on the Wash and on the Firth of Forth. Results from ringing confirm the use of Heligoland by Irish birds but use of other moulting areas is unsubstantiated. In cold winters, the UK may receive migrants from the continent or, if cold weather affects the UK, birds may migrate further south towards southern Europe.

Numbers of Shelduck at Strangford Lough rose steadily from September/October to peak in mid-winter (Figure 3.2.4a). In 1988/89, the peak was considerably greater and earlier, occurring in December, than in previous years when numbers had been

relatively stable. The reason for this marked increase is not clear. By March, birds disperse to breeding sites.

Distribution within Strangford Lough

Shelduck are most common in sections 1 and 2, occupying section 1 before section 2 and peaking there in January, whilst peaking in section 2 in February (Figure 3.2.4b). The remaining sections are little-used, although sections 3 and 4 have more birds present as the winter progresses.

Long-term population trends

Shelduck have shown an upward trend in both peak winter and January counts (Figures 3.2.4c & d) since 1965. This represents a greater increase than that shown by the January index for the North West European Flyway, which has shown only slightly increased levels over a similar time period (Figure 3.2.4e).

3.2.5 Wigeon Anas penelope

Average peak winter count	- 1,888
All-Ireland population estimate	- 150,000
UK population estimate	- 270,000
Flyway population estimate	- 750,000

Origins, migration and seasonal abundance

Approximately 10% of the Wigeon from the breeding population in Scandinavia and central Siberia overwinter in Ireland, after migrating through southern England (Owen et al. 1986). In cold winters, this proportion is higher (Owen & Mitchell 1988). Most of the Wigeon wintering at Strangford Lough are thought to belong to this population, which arrive in October/November.

There is also a small breeding population in Iceland which migrates via Scotland and northern England to Ireland where most

overwinter (Owen & Mitchell 1988). These birds arrive from late August onwards (Hutchinson 1989).

The timing of peak numbers of Wigeon at Strangford Lough is variable. There is usually a sharp increase in October and numbers then remain high through to the end of February (Figure 3.2.5a). By March, many Wigeon have departed. Year to year variation in numbers of Wigeon over the five year period, 1984/85 to 1988/89 was slight. The patterns of abundance of this species are discussed in detail in Fox et al. 1990.

Distribution within Strangford Lough

Sections 1, 2 and 3 are most important to Wigeon, with section 1 having peak numbers occurring in October, whilst peak use of sections 2 and 3 occurs in December and January respectively (Figure 3.2.5bi). Sections 4 and 5 are little-used.

Within section 1, the north shore, count zones E70 to F30 (Figure 2) inclusive hold most birds, although few/none are present after December (Figure 3.2.5bii). This site preference overlaps with that of Brent Geese (Figure 3.2.3bii). The Comber Estuary and the north-west corner of the lough are used mainly in October, soon after birds arrive and a time when peak numbers of Wigeon tend to be present on the lough.

Along the west shore, section 2, most Wigeon occur on the muddy areas enclosed by Mahee Island between November and February, peak numbers occurring in January (Figure 3.2.5biii).

The south shore, section 3, becomes important later in the winter, with the mouth of the Quoile accommodating up to 700 Wigeon during December to February (Figure 3.2.5biv), peak numbers occurring there in December.

There appears to be a tendency for Wigeon to move south through the lough as the winter progresses.

Long-term population trends

Wigeon numbers increased during the late 1960s to peak in the early 1970s, since when they have declined to very low levels (Figures 3.2.5c & d). The January index for the North West European Flyway population has been stable or increasing slightly throughout a similar period (Figure 3.2.5e). This pronounced drop in the Wigeon numbers at Strangford Lough is investigated in more detail by Fox et al. (1990).

3.2.6 Gadwall *Anas strepera*

Average peak winter count	-	92
All-Ireland population estimate	-	450
UK population estimate	-	5,000
Flyway population estimate	-	12,000

Origins, migration and seasonal abundance

The North West European population has increased dramatically, in recent years, possibly aided by introductions (Owen et al. 1986). This population includes birds from the Icelandic and Scottish breeding populations, which are thought to constitute the bulk of the Irish wintering population. There is also evidence of birds from eastern European breeding areas migrating to Britain and Ireland for the winter (Fox & Mitchell 1988) as well as ringing recoveries which indicate that Gadwall from southern England, Denmark, the Netherlands and West Germany visit Ireland in winter.

Gadwall arrive at Strangford Lough from September onwards, increasing steadily to peak in mid-winter (Figure 3.2.6a). The exact timing of the peak varies. Numbers decrease in February/March. There were particularly high numbers of Gadwall at Strangford Lough in the winter of 1985/86.

Distribution within Strangford Lough

Section 4 has had few/no Gadwall recorded in it. No strong preference has been observed for any one of the remaining sections

of the lough, although timing of peak use varies. Peak use of sections is in November, December, January and February for sections 2, 3, 1 and 5, respectively (Figure 3.2.6b).

Long-term population trends

Gadwall were infrequent visitors to Strangford Lough until 1980/81, following which their numbers increased rapidly to peak in 1985/86 (Figures 3.2.6c & d). Subsequently, the trend has been downwards until 1989/90 when there was an upward turn. The January index for the North West European Flyway population increased up to 1980, since when it has dropped slightly (Figure 3.2.6e). The greater numbers of Gadwall at Strangford Lough seem to be due to an expansion of range by this species.

3.2.7 Teal Anas crecca

Average peak winter count	- 985
All-Ireland population estimate	- 50,000
UK population estimate	- 100,000
Flyway population estimate	- 400,000

Origins, migration and seasonal abundance

Teal from breeding areas in Iceland winter in Ireland and Scotland, supplemented by birds from local breeding populations and from Russia, Fenno-Scandia and central Europe (Hutchinson 1989; Prater 1981). Teal have a widespread distribution which may be modified substantially in cold winters.

Numbers of Teal at Strangford Lough increase steadily to peak in December/January, declining thereafter (Figure 3.2.7a).

Long-term population trends

Overall, numbers of Teal at Strangford Lough have increased (Figure 3.2.7c & d). Similarly, the Flyway index had been increasing until the 1980s, during which it has declined (Figure 3.2.7e).

3.2.8 Mallard *Anas platyrhynchos*

Average peak winter count	-	1,759
All-Ireland population estimate	-	50,000
UK population estimate	-	500,000
Flyway population estimate	-	5,000,000

Origins, migration and seasonal abundance

Most Mallard overwintering in Ireland are resident breeding birds. These birds are supplemented by visitors from other western European countries plus some from the Baltic countries (Hutchinson 1989; Monval & Pirot 1989; Prater 1981).

Movement to wintering sites starts in August and, at Strangford Lough numbers reach a peak in September or October (Figure 3.2.8a). Overall, a steady decline is discernable thereafter. Year to year variation has been slight, although there were higher than usual numbers of Mallard in December 1987.

Distribution within Strangford Lough

Section 2 is the most-used, with only section 4 of negligible importance (Figure 3.2.8b).

Long-term population trends

Both January and peak winter counts show similar trends, with an early increasing phase followed by a decline from 1971/72 (Figures 3.2.8c & d). Since the mid-1970s, the general trend has been upwards. This pattern is the inverse of the January index for the North West European population, with increases on Strangford Lough coinciding with decreases of the Flyway index and vice versa (Figure 3.2.8e).

3.2.9 Shoveler *Anas clypeata*

Average peak winter count	-	131
All-Ireland population estimate	-	4,200
UK population estimate	-	9,000
Flyway population estimate	-	40,000

Origins, migration and seasonal abundance

Many Shoveler, including local breeders, migrate to southern Europe for the winter. Peak numbers occur at Strangford Lough in mid-winter (Figure 3.2.9a), following a steady increase during October/November as migrants arrive from, principally, the USSR, Iceland and Scandinavia (Hutchinson 1989; Prater 1981). There is evidence, too, for some Shoveler migrating from Scotland and northern England to overwinter in Ireland (Hutchinson 1989). Numbers of Shoveler tend to decrease in March. However, seasonal use of Strangford Lough is variable from year to year.

Distribution within Strangford Lough

Section 2 is most-used with peak numbers present in December and January (Figure 3.2.9b). Sections 4 and 5 have few birds at any time. Peak use of section 1 is in February, whilst section 3 is used most in November and February.

Long-term population trends

Counts of Shoveler at Strangford Lough in January have shown marked fluctuations (Figure 3.2.9d), with an underlying increasing trend from 1967/68 onwards. This upward trend matches that of the January index for North West Europe (Figure 3.2.9e). The peak winter counts increased from 1967/68 and were moderately stable between 1968/69 and 1975/76 before declining in 1976/77. Subsequently, there has been an overall increase (Figure 3.2.9c).

3.2.10 Goldeneye *Bucephala clangula*

Average peak winter count	- 409
All-Ireland population estimate	- 10,000
UK population estimate	- 25,000
Flyway population estimate	- 300,000

Origins, migration and seasonal abundance

Goldeneye from breeding grounds in Scandinavia, principally northern Sweden, overwinter in Ireland (Hutchinson 1989). Approximately 3% of the Goldeneye from the North West and Central European population move to Ireland in winter, although cold weather influxes increase this proportion (Monval & Pirot 1989).

Numbers of Goldeneye at Strangford Lough increase from September to November (Figure 3.2.10a), as migrants arrive from breeding grounds. Considerable annual variation in numbers has been apparent thereafter. In 1987/88, the highest numbers of Goldeneye were recorded on Strangford Lough, with over 700 birds counted in February.

Distribution within Strangford Lough

Sections 1, 2, and 3 are most-used (Figure 3.2.10b). The pattern of use of these sections is very similar with increases as the winter progresses. Sections 4 and 5 have few birds generally and do not show the trend of increase of the other sections.

Long-term population trends

Peak winter and January counts show similarities with relatively stable numbers up to the early 1980s, followed by a series of years with many more birds on Strangford Lough (Figures 3.2.10c & d). The January index for the Flyway population shows two, approximately, stable periods from 1967/68 to 1976/77 and from 1977/78 to 1986/87 at a higher level (Figure 3.2.10e). The trend is similar, for the comparable timescale, to that for Strangford Lough.

3.2.11 Oystercatcher *Haematopus ostralegus*

Average peak winter count	- 4,587
All-Ireland population estimate	- 70,000
UK population estimate	- 300,000
Flyway population estimate	- 874,000

Origins, migration and seasonal abundance

In winter, local breeders are supplemented by birds from Scotland, the Faeroes, Iceland and Norway, with additional influxes from the Netherlands in cold winters (Prater 1981; Smit & Piersma 1989). However, some local breeders migrate south to overwinter in France and Iberia (Hutchinson 1989). Approximately 13% of the North West European Flyway population overwinter in Ireland.

Post-breeding migrants arrive from late July. Numbers of Oystercatchers peak at Strangford Lough in September/October and, in some years, in December/January (Figure 3.2.11a). The latter peak is probably due to influxes from Britain and the continent in mid-winter. Year to year variation in seasonal abundance has been small.

Distribution within Strangford Lough

Section 1 has approximately 75% of the lough's Oystercatchers, with remaining sections of little importance (Figure 3.2.11b). Numbers remain high in section 1 throughout the winter.

Long-term population trends

The overall trend is upwards for numbers of Oystercatchers at Strangford Lough (Figures 3.2.11c & d), in keeping with the UK January index (Figure 3.2.11e).

3.2.12 Golden Plover *Pluvialis apricaria*

Average peak winter count	- 9,082
All-Ireland population estimate	- 100,000
UK population estimate	- 200,000
Flyway population estimate	- -

Origins, migration and seasonal abundance

Migrants from the Icelandic breeding population (*P. a. altifrons*) supplement local breeders (*P. a. apricaria*) on their wintering grounds in Ireland (Hutchinson 1989; Prater 1981). Golden Plover are considered to be, principally, inland wintering birds, making use of estuaries mainly in cold weather or as roost sites.

Following, the October influx of migrants, flocks disperse to scattered inland feeding sites. Peak numbers usually occur at Strangford Lough in December (Figure 3.2.12a). Influxes occur in some years, in any month from October to February. By March winter flocks have departed for breeding areas.

Distribution within Strangford Lough

Golden Plover occur principally in section 1, other sections having few birds (Figure 3.2 12bi). Within section 1, most Golden Plover are to be found at the mouth of the Comber Estuary, peaking in December (Figure 3.2.12bii).

Long-term population trends

Fluctuations in January counts are considerable, as would be expected for a species which uses inland sites and shows marked cold weather movements (Figure 3.2.12d). Peak winter counts show an upward trend (Figure 3.2.12c).

3.2.13 Lapwing Vanellus vanellus

Average peak winter count	-	13,883
All-Ireland population estimate	-	200,000
UK population estimate	-	1,000,000
Flyway population estimate	-	-

Origins, migration and seasonal abundance

Lapwing have a widespread distribution. Many of the Lapwing from breeding areas in central Scotland and northern England overwinter in Ireland, with additional birds from Scandinavia, Belgium, the Netherlands and Germany (Hutchinson 1989). In winter, inland sites are used, with visits to estuaries associated mainly with severe weather when inland sites are frozen, or for roosting. Consequently, like Golden Plover, interpretation of Strangford Lough count data is inadequate to explain distribution of this species in that locality. (Figure 3.2.13a).

Long-term population trends

A period of relative stability through the 1970s has been followed by an increasing trend in peak winter counts up to 1986/87 (Figure 3.2.13c). Subsequently, there has been a decline. January counts are erratic owing to use of inland sites (Figure 3.2.13d).

3.2.14 Knot Calidris canutus

Average peak winter count	-	9,824
All-Ireland population estimate	-	25,000
UK population estimate	-	220,000
Flyway population estimate	-	512,000

Origins, migration and seasonal abundance

Nearctic Knot, of the race islandica, come from breeding areas in northern Greenland and northeast Canada (Prater 1981) and migrate to wintering areas around the North Sea coast (Smit & Piersma 1989). Knot wintering at Strangford Lough are from this race.

Migration is via Iceland, although Knot are capable of migrating long distances in single flights. The main influx of wintering birds to the UK occurs in August, followed by further immigration and onward migration from November after moult. This second phase of migration brings birds to Strangford Lough. During spring migration, Knot use staging areas in northern Norway (Davidson et al. 1986) and Iceland.

It is thought that the East Atlantic Flyway population (islandica) has been declining, evidenced particularly in the decreased numbers wintering in Ireland, Britain, France and, to a lesser degree, the Netherlands. A series of bad breeding seasons is considered to be the main cause of this decline (Smit & Piersma 1989).

Numbers at Strangford Lough were relatively low except in December and January of 1984/85 and 1985/86 (Figure 3.2.14a). These mid-winter peaks, which brought in up to 20,000 extra birds, have not recurred. Mid-winter influxes of Knot from the Wadden Sea area, to sites in the UK, are regular occurrences, particularly in cold winters. Both 1984/85 and 1985/86 had prolonged spells of freezing conditions (Salmon et al. 1985 & 1987). Low numbers of Knot at Strangford Lough in recent winters (Figure 3.2.14c) correspond with a series of exceptionally mild winters, but may also be attributable to declines in the population of nearctic Knot.

Distribution within Strangford Lough

Section 1 is the main one for Knot (Figure 3.2.14bi), with over 90% of the birds present during the January peak occurring there. The northwest corner of the lough is the preferred part of the north shore for Knot, being the first area to be occupied in September and with a peak of one quarter of all Knot on Strangford Lough occurring here (Figure 3.2.14bii).

Long-term population trends

Numbers of Knot have declined slightly overall since the late 1970s, in keeping with the UK January index which has declined

from the 1972/73 peak to a moderately stable level from 1979 (Figure 3.2.14e). Exceptional peaks occurred in some winters, notably 1971/72, 1984/85 and 1985/86 (Figure 3.2.14c & d); see comments above. No such peak occurred in the winter of 1981/82, when there were also lengthy periods of sub-zero temperatures, but Knot can be erratic in their movements within a single winter and so may have visited other sites. The Ribble had particularly high numbers of Knot during the winter of 1981/82 (Salmon & Moser 1985), which may have included birds that would visit Strangford Lough in other winters. In the absence of ringing recovery data, this suggestion is purely speculative.

3.2.15 Dunlin *Calidris alpina*

Average peak winter count	-	5,704
All-Ireland population estimate	-	100,000
UK population estimate	-	440,000
Flyway population estimate	-	1,373,000

Origins, migration and seasonal abundance

The nominate race *alpina*, from breeding areas in the northwest USSR and arctic Scandinavia, winters in North West Europe (Smit & Piersma 1989). Migration is through the Baltic, with moulting stopovers on the Wadden Sea or east coast British estuaries such as the Wash (Prater 1981). Onward, post-moult migration takes place in October/November and is generally westerly and southerly, bringing birds to Ireland. Numbers of Dunlin at Strangford Lough often peak at this time (Figure 3.2.15a). Juveniles arrive from August through to the end of November. Strangford Lough appears to be a staging post for dispersal to other sites in Ireland. Cold weather movements supplement wintering numbers in Ireland. Numbers of Dunlin at Strangford Lough usually peak again in January/February, before declining as birds leave for breeding grounds. Return migration starts in February and follows a similar route, in reverse, to that used in autumn.

Passage through Strangford Lough of *C.a. schinzii*, which includes Irish breeding birds (Hutchinson 1989), and a few of *C.a.*

arctica, which breed in northeast Greenland, occurs from June to September, with juveniles predominantly in August, as birds migrate to African wintering areas. Return passage of these two races takes place in April and May.

Distribution within Strangford Lough

Section 1 is used by the majority of Dunlin with sections 2 and 3 being of secondary importance (Figure 3.2.15b). Sections 1 and 3 have peak numbers in November, when most Dunlin are present on Strangford Lough. Sections 4 and 5 have few birds.

Long-term population trends

Peak winter and January counts show an overall increase (Figure 3.2.15c & d), in contrast with the decreasing trend of the UK January index (Figure 3.2.15e).

3.2.16 Black-tailed Godwit *Limosa limosa*

Average peak winter count	- 172
All-Ireland population estimate	- 8,000
UK population estimate	- 5,000
Flyway population estimate	- 66,000

Origins, migration and seasonal abundance

Black-tailed Godwits of the race *L.l. islandica*, which breed mainly in Iceland, but also include the small Irish breeding population, migrate to Ireland from July to September to moult and overwinter (Hutchinson 1989; Smit & Piersma 1989; Prater 1981). First year birds arrive from the end of August. Numbers at Strangford Lough show considerable fluctuations, but usually peak in autumn (Figure 3.2.16a), before most birds continue a southerly migration. Thereafter, numbers decline steadily. In April, numbers increase in Ireland, as birds start the return migration to Iceland.

Distribution within Strangford Lough

Section 2 is used by most Black-tailed Godwit, with only section 3 also having significant numbers (Figure 3.2.16bi). Section 3 is occupied first and has peak numbers in September. Peak use of section 2 is in November. Within section 2, all birds occur on predominantly fine-mud substrates in Ardmillan and Ringneill Bays and around the mid-lough islands (Figure 3.2.16bii).

Long-term population trends

Counts show pronounced fluctuations (Figures 3.2.16c & d). The overall tendency for Peak winter counts is upwards.

3.2.17 Bar-tailed Godwit *Limosa lapponica*

Average peak winter count	-	1,057
All-Ireland population estimate	-	23,000
UK population estimate	-	62,000
Flyway population estimate	-	115,000

Origins, migration and seasonal abundance

The nominate race, *L.l. lapponica* breeds in arctic and sub-arctic regions of northern Scandinavia across to the eastern Taymyr peninsula (Hutchinson 1989; Smit & Piersma 1989). This population winters in western Europe and West Africa. Autumn migration is via the Baltic from late July until mid-August, with moulting stopovers at the Wadden Sea, Wash, Ribble or Morecambe Bay. First winter birds arrive in the UK during September. Onward, post-moult migration takes place mainly from November to more southerly and westerly wintering areas. Spring passage begins in February, with the Wadden Sea providing the main refuelling stopover (Prater 1981). Cold weather movements affect the distribution of this species.

Numbers of Bar-tailed Godwit at Strangford Lough are variable throughout the winter, with only September and March showing any

year to year consistency (Figure 3.2.17a). In January 1985, numbers were higher than at any other time in the five years.

Distribution within Strangford Lough

The muddy sand substrates of section 1 are the most important for Bar-tailed Godwit on Strangford Lough, with only section 2 having appreciable numbers too (Figure 3.2.17bi). Section 2, notably the mid-lough islands (Figure 3.2.17biii), is occupied first and its peak use is in September. Thereafter, section 1 is used almost exclusively with birds being fairly evenly distributed along the northern shore (Figure 3.2.17bii). Peak numbers are present there in January.

Long-term population trends

Counts show marked fluctuations throughout the 24 years (Figures 3.2.17c & d), with several particularly high counts during the mid 1970s to mid 1980s. The January index for the UK has increased overall (Figure 3.2.17e). The use of Strangford Lough by Bar-tailed Godwit in winter is erratic, maxima occurring usually in cold winters.

3.2.18 Curlew Numenius arquata

Average peak winter count - 1,682
All-Ireland population estimate - 100,000
UK population estimate - 98,000
Flyway population estimate - 348,000

Origins, migration and seasonal abundance

Curlew which winter in Ireland are from breeding areas in Scotland, northern England and Norway, as well as from local sites (Hutchinson 1989). These birds start to arrive on the wintering grounds from June to July and commence post-nuptial moult. First winter birds do not arrive until mid-September (Prater 1981). Numbers of Curlew at Strangford Lough peak in September, before birds disperse to inland sites (Figure 3.2.18a).

Numbers remain relatively high throughout the winter and show little year to year variation. There is a tendency for a mid-winter peak, probably due to birds returning to the estuary when inland feeding areas freeze. Curlew will migrate in response to cold weather.

Distribution within Strangford Lough

Curlews use all sections of Strangford Lough, although section 1 has the most birds (Figure 3.2.18b). Peak use of each section occurs in September (except section 5) and in mid-winter, when peak numbers of Curlew are present on the lough.

Long-term population trends

Numbers of Curlew at Strangford Lough rose to a peak in the early 1970s, since when, although fluctuating, the general trend seems to be downwards (Figure 3.2.18c & d), as is the case for the UK January index (Figure 3.2.18e). Numbers have been increasing during the late 1980s.

3.2.19 Redshank *Tringa totanus*

Average peak winter count	- 3,100
All-Ireland population estimate	- 25,000
UK population estimate	- 82,000
Flyway population estimate	- 109,000

Origins, migration and seasonal abundance

T.t. robusta, which breeds in Iceland and in small numbers in the Faeroes, winters in southern Iceland and Norway, Ireland and countries bordering the North Sea. British and Irish breeders, of the race *T.t. britannica*, are primarily resident (Smit & Piersma 1989), although some Redshank from Scotland and northern England migrate to Ireland to overwinter (Hutchinson 1989). Autumn migration begins in July with influxes of Icelandic birds in August. The peak at Strangford Lough occurs in September/October (Figure 3.2.19a). Numbers remain fairly high and stable

throughout the winter, with little year to year variation. Spring departures may occur as early as January, but most migratory activity occurs in late March to May as Icelandic birds leave and Redshank which have wintered further south pass through (Prater 1981).

Distribution within Strangford Lough

Sections 1 and 2 have most Redshank with other sites being little used (Figure 3.2.19b). Peak use of section 2 occurs in October, whilst section 1 has peak numbers in January.

Long-term population trends

Both peak winter and January counts for Strangford Lough show an upward trend, although that for the whole winter includes a plateau phase from 1968/69 to 1977/78 (Figure 3.2.19c & d). This trend is contrary to that for the UK January index which shows a decline over a similar period (Figure 3.2.19e). However, Clark (1989) showed an increase in the index, if peak winter counts (November to March) are used instead of January counts, so the increase in numbers of Redshank at Strangford Lough may be representative of the UK trend.

3.2.20 Turnstone *Arenaria interpres*

Average peak winter count	-	428
All-Ireland population estimate	-	10,000
UK population estimate	-	48,000
Flyway population estimate	-	67,000

Origins, migration and seasonal abundance

Turnstone wintering in Ireland come from breeding populations in Greenland and northeastern Canada (Smit & Piersma 1989; Prater 1981), and migrate via Iceland. In Ireland, Turnstone occur mainly along rocky shores. Turnstone are most common in Ireland

during spring and autumn passage when Scandinavian breeders are also present, most of which winter in Africa and Iberia (Prater 1981).

Long-term population trends

Overall, Turnstone numbers have increased, in line with the UK January index (Figures 3.2.20c, d & e).

4. DISCUSSION

Conservation importance

Strangford Lough qualifies as a wetland of international importance for its wintering wildfowl and waders and, therefore, fulfils the criteria required for designation as a Ramsar site and Special Protection Area.

Resident breeding birds are augmented in autumn and winter by migrants from Fenno-Scandia, Canadian/Greenland arctic and Iceland in particular. Additionally, cold weather influxes from continental Europe and Britain occur in some years, a phenomenon prevalent in a few species e.g. Bar-tailed Godwit (Figure 3.2.17c). Consequently, there is an obligation to ensure that adequate protection is afforded to these international populations of waterfowl.

Distribution within Strangford Lough

Within the lough, two key sections can be identified as having the majority of waterfowl; the northern and western shores.

The northern mudflats (Figure 1) are pre-eminent for most species, particularly to waders and grazing wildfowl. These mudflats have rich beds of Zostera, among the most prolific in Europe (Pritchard 1982a & b), which attract Wigeon and Brent Geese to graze and Shelduck and waders to feed on the associated fauna. The densest sward is available in autumn, leading to the concentrations of Wigeon and Brent Goose along the north shore at this time (Figures 3.2.5bi & ii and 3.2.3bi & ii). Peak numbers of Brent Goose occur at Strangford Lough in autumn to coincide with the best Zostera growth (Figure 3.2.3a).

Brent Goose continue to feed along the northern shore after the autumn flush of Zostera growth, particularly along the northeast section at the maltings outfall. However, by mid-winter geese disperse both in small flocks within the lough (Figure 3.2.3bi)

and away from Strangford Lough, particularly to the Co. Dublin coast (Hutchinson 1989; Pritchard 1982a).

Sequential use of sections by Wigeon is particularly apparent, with increases on the western southern shores coinciding with declines in the use of the northern mudflats from November when Zostera levels there are depleted (Figure s 3.2.5bi, iii & iv). The Quoile provides freshwater feeding options for Wigeon.

The patterns of use of Zostera beds by Wigeon and Brent Geese are investigated more fully in Fox et al. (1990).
Diving and dabbling ducks are less reliant on any one section and so tend to be more widespread, e.g. Mallard show a similar pattern of monthly occupation of all sections, although there are more birds in section 2 than in any other section (Figure 3.2.8b). The narrows and eastern shore are generally avoided by most species, although low numbers of widespread species occur along these sections, notably those which utilise rocky shores, e.g. Curlew and Oystercatcher (Figures 3.2.11b & 3.2.18b).

The finer muds of the western shore are favoured by Black-tailed Godwit (Figure 3.2.16bi & ii) and Shoveler (Figure 3.2.9b). Bar-tailed Godwit favour this area in autumn, but soon increase on the northern mudflats to leave few birds on the western shore (Figure 3.2.17bi & iii).

There is a tendency for use of less favoured sections, by a species, to coincide with times of its peak numbers on the lough, e.g. Shelduck (Figure 3.2.4b).

Species-specific patterns of section use are identifiable. Further research should ascertain the seasonal use of sections in winters when there were large numbers of a species and compare these with winters of low numbers, to determine whether birds are forced into suboptimal habitats when high numbers of birds are present on the lough.

Long-term population trends

Table 3 summarises the main population trends for the selected wildfowl and wader species which have been considered in detail. Several species have shown increasing trends (Table 3). Brent Goose has increased slightly overall (Figure 3.2.3c & d), but has periodic slumps in numbers. This apparent anomaly seems to be due to the cyclical nature of periods of decline (Figure 3.2.3c) in arctic-breeding birds, which have been associated with similar cyclicity in arctic mammals (Summers 1986; Summers & Underhill 1987). Predators switch to avian prey in years when lemming numbers are low, hence poorer productivity by arctic breeding birds in those years and, consequently, lower numbers on the wintering areas than following good breeding seasons.

For most of the selected species, long-term population trends at Strangford Lough are similar to the trends for flyway (wildfowl) and UK (waders) indices. Exceptions include Dunlin (Figure 3.2.15c, d & e) and Redshank (Figure 3.2.19c, d & e), both of which have shown increases at Strangford Lough contrary to the declines in their respective indices. However, the apparent decline in the UK index (based on January counts alone) for Redshank may be an artefact, since Clark (1989) showed that the UK index based on peak winter counts (November to March) has in fact increased over recent years.

Whilst many species have shown increases at Strangford Lough, there have been declines in others which indicate localised, detrimental, changes. The major decline in Wigeon (Figure 3.2.5c & d) took place in the early 1970s. Numbers have remained stable although at a low level since then. The decline at Strangford Lough is a local phenomenon, contrasting with the trend for the flyway, and is addressed in more detail by Fox et al. (1990).

The decrease in Whooper Swan (Figure 3.2.2c & d) also conflicts with the "all-Ireland" picture (Hutchinson 1989) which shows a pronounced increase.

An assessment of nutrient levels in the lough, particularly if longitudinal comparisons are possible, may contribute towards a greater understanding of population trends at Strangford Lough. Increases in species such as Goldeneye, Dunlin and Redshank may relate to increased nutrient input (Campbell 1978; Furness et al. 1986). Green (1990) gives a useful appraisal of studies on the effects of nutrient inputs on birds.

An attempt has been made to explain population trends which show increases or decreases, particularly where these are contrary to the flyway or UK indices, or where changes in populations at Strangford Lough have been dramatic.

Table 3 Summary of population trends for selected species of wildfowl and waders at Strangford Lough

Decrease	Stable	Increase
Mute Swan	Goldeneye	Brent Goose
Whooper Swan	Bar-tailed Godwit	Shelduck
Wigeon		Gadwall
Knot		Teal
		Mallard
		Shoveler
		Oystercatcher
		Lapwing
		Golden Plover
		Dunlin
		Black-tailed Godwit
		Redshank
		Turnstone

5. RECOMMENDATIONS

It is recommended that Strangford Lough should be designated a Ramsar site and Special Protection Area (SPA).

A programme of ringing and recapture studies would aid identification of the role of Strangford Lough in relation to other sites both during migration and during the winter, by revealing the identity of alternative sites, as well as confirming the breeding origins of waterfowl which visit Strangford Lough. Capture/recapture methods would also help to interpret distributional changes within the lough.

The Strangford Lough database supplies an invaluable long-term record of population trends on an estuary site and, consequently, continuation of waterfowl counts is highly recommended to extend this run of data. This data will acquire even greater significance once indices for all-Ireland are available.

The establishment of annual counters' meetings would encourage participation, help to resolve practical problems in carrying out counts, and provide feed-back from the scheme. Improvements to count quality could also be achieved by supplying counters with telescopes. These would reduce identification problems associated with counting over long distances.

Invertebrate sampling of those areas which hold most birds would contribute to a better understanding of bird distributions within the lough.

There is further scope for analyses of this large data set, which should be tackled. A more detailed assessment of distributional patterns within the lough - seasonal variations, relationship to intertidal area of sections, ordination of species distribution with habitat features, longitudinal studies - would allow firmer conclusions to be made concerning species variation and the importance of different sections of the lough.

ACKNOWLEDGEMENTS

This report would not have been possible without the enormous committment of counters and count organisers who have amassed one of the most comprehensive sets of count data in Britain and Ireland. The Department of the Environment for Northern Ireland has provided financial support for the waterfowl counts and funded this commissioned report for the Review.

Thanks are due to Bob Brown, head warden of Strangford Lough for the National Trust, for showing me around the lough and for responding so promptly to all my requests for information; Paul Rose of IWRB for transposing the count data into a form suitable for use at the BTO; Mike Moser and Robert Prys-Jones for constructive criticism of an earlier draft of this report; Ralph Sheppard for supplying pre-publication population estimates for all-Ireland; colleagues at the BTO for assistance with computing problems, notably Jeff Kirby, Nigel Clark, Martin Sneary and Phil Whittington.

Figure 1 Substrate types on Strangford Lough

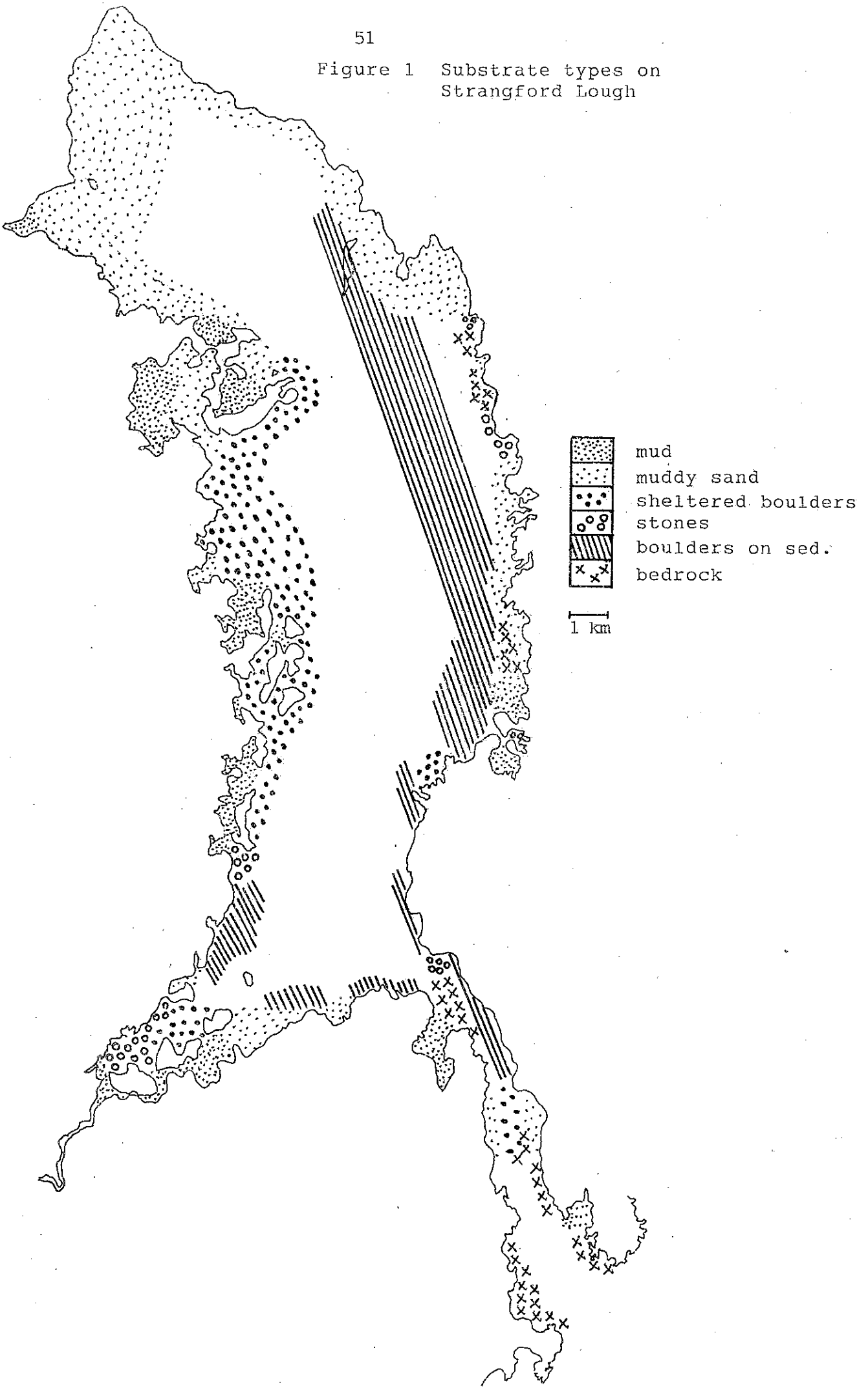


Figure 2 Counting zones around Strangford Lough

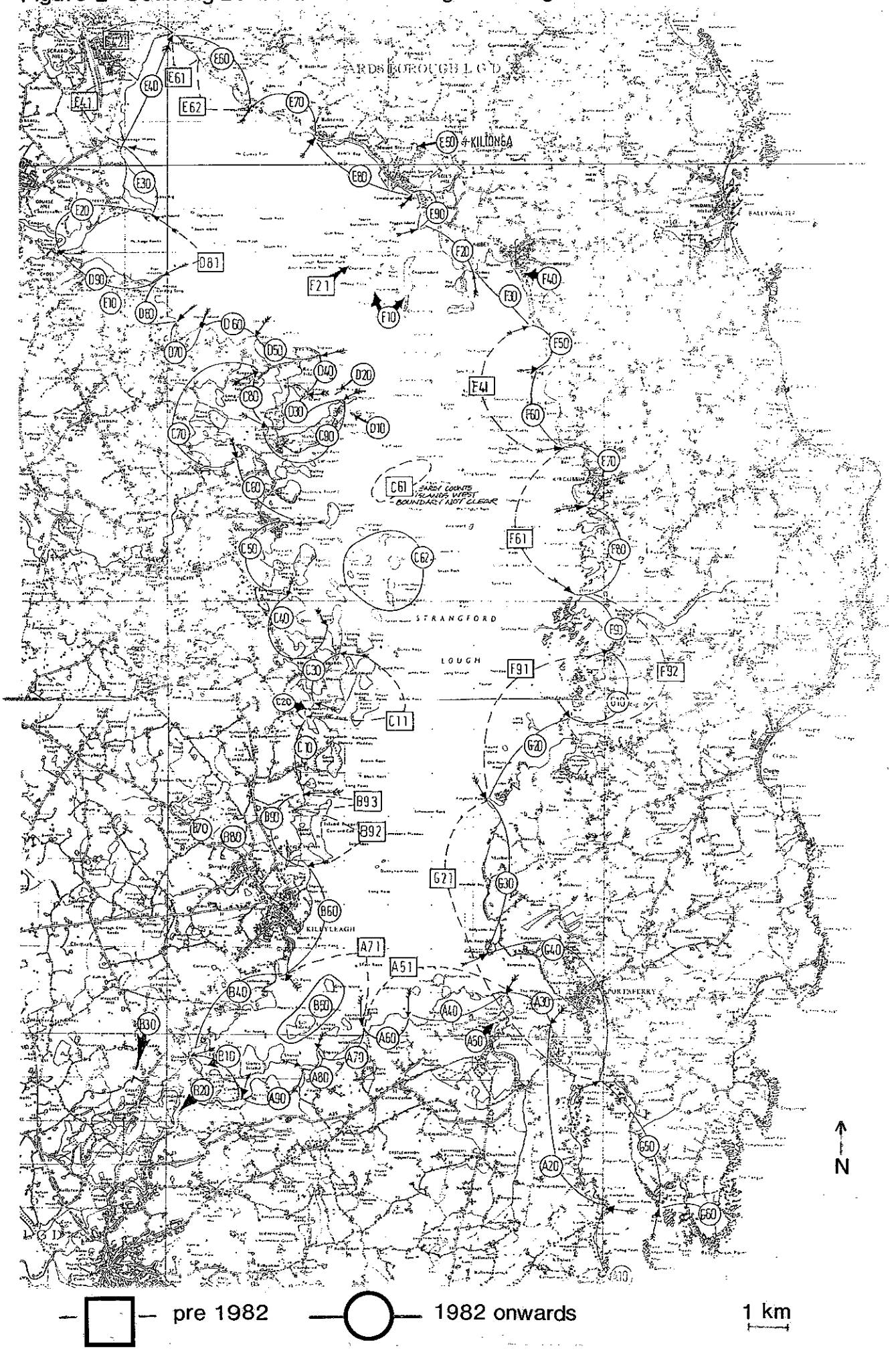
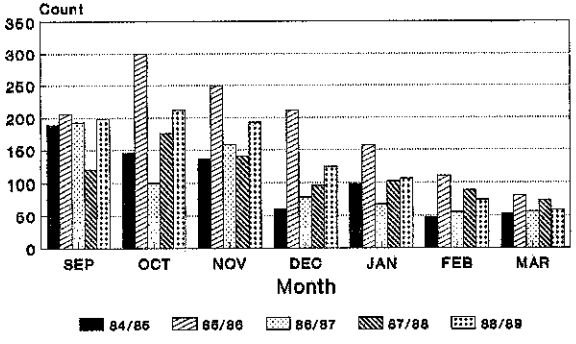
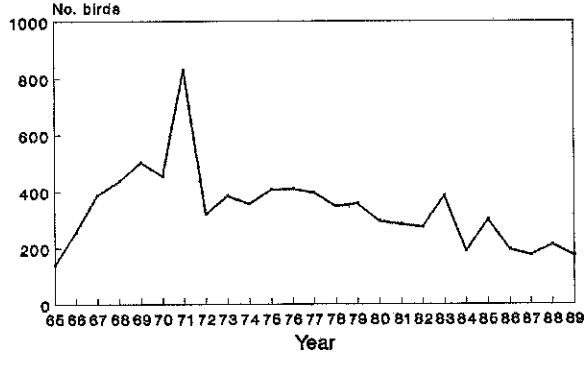


Figure 3.2.1 MUTE SWAN

a. Seasonal abundance



c. Peak winter counts



d. January counts

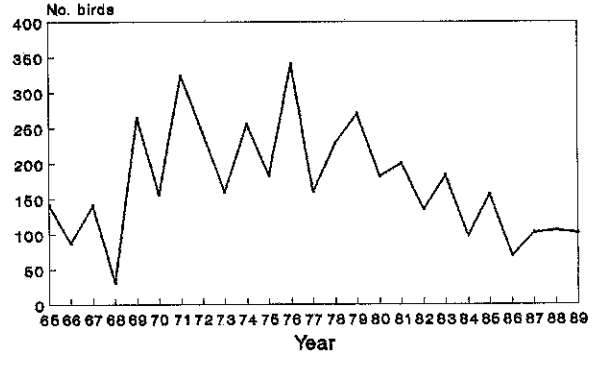
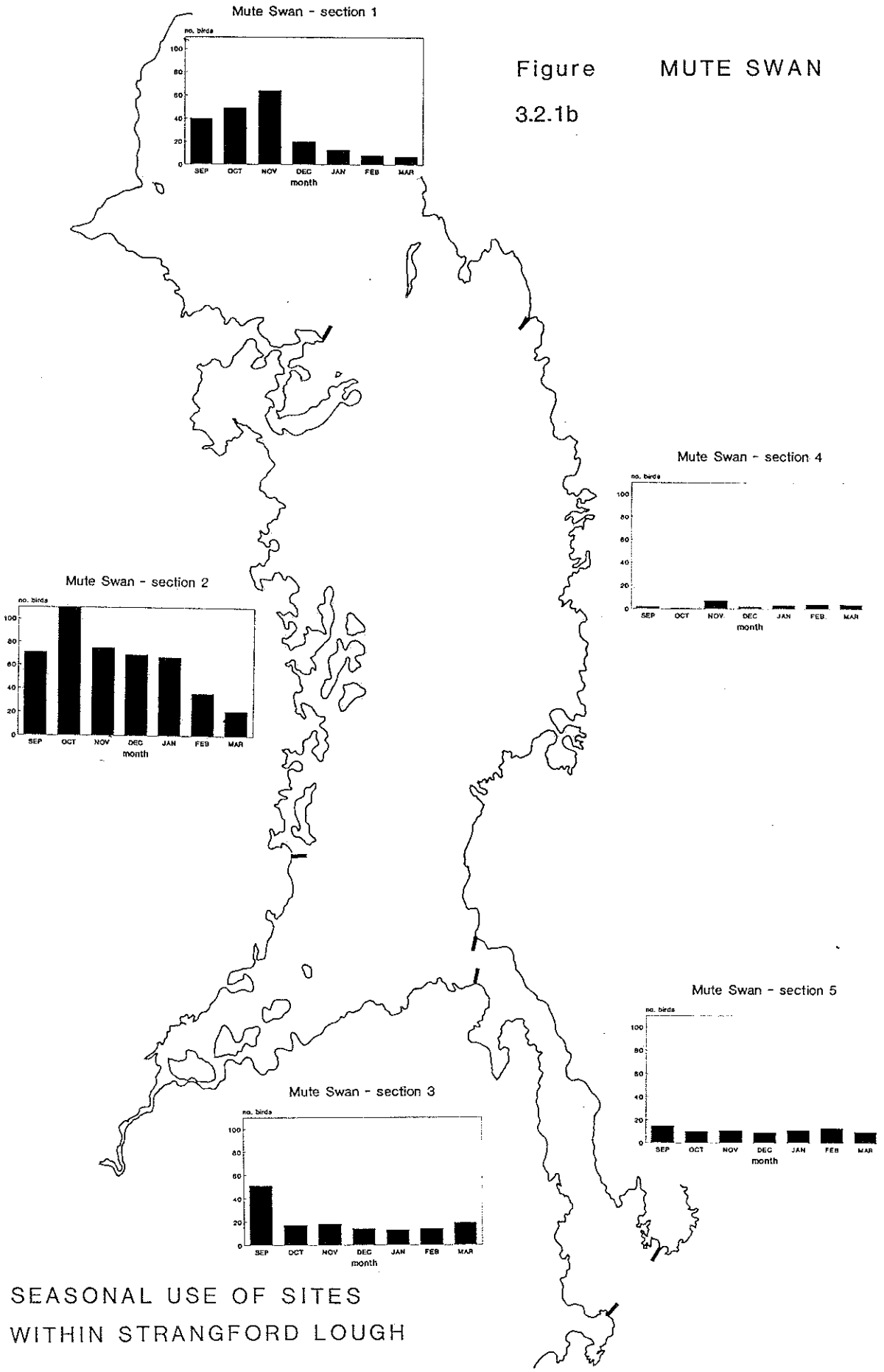


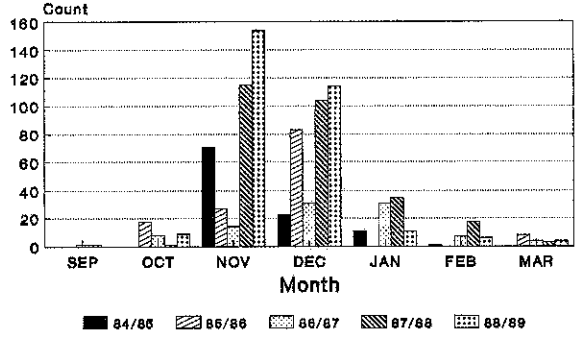
Figure 3.2.1b MUTE SWAN



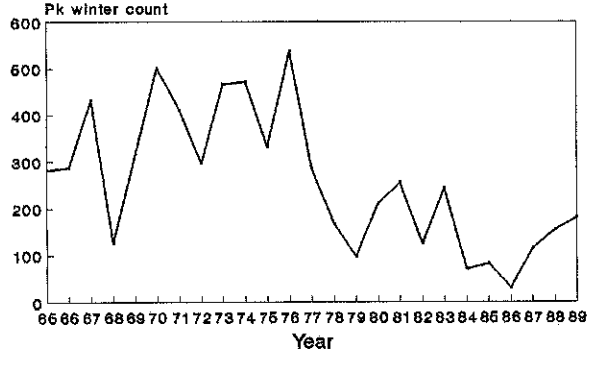
SEASONAL USE OF SITES
WITHIN STRANGFORD LOUGH

Figure 3.2.2 WHOOPER SWAN

a. Seasonal abundance



c. Peak winter counts



d. January counts

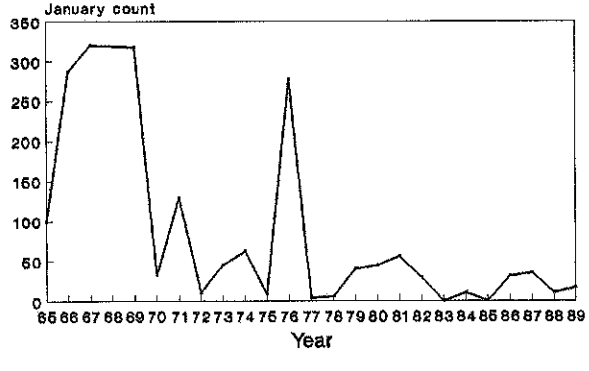
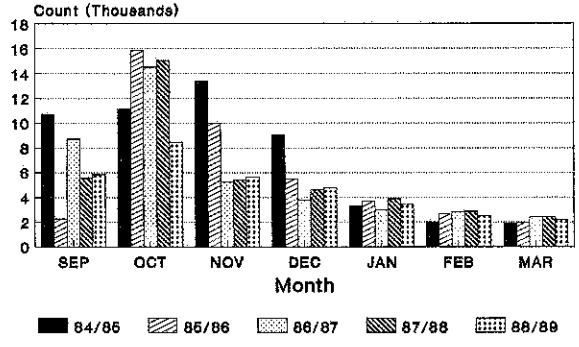
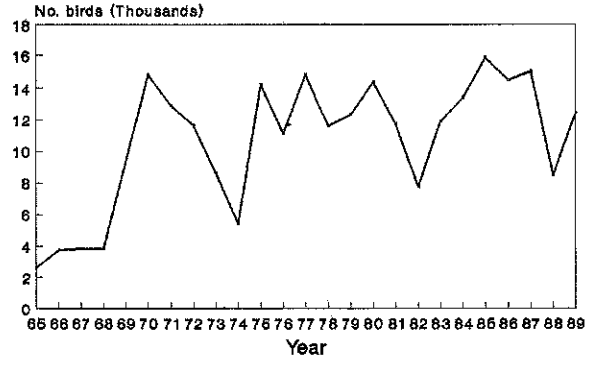


Figure 3.2.3 BRENT GOOSE

a. Seasonal abundance



c. Peak winter counts



d. January counts

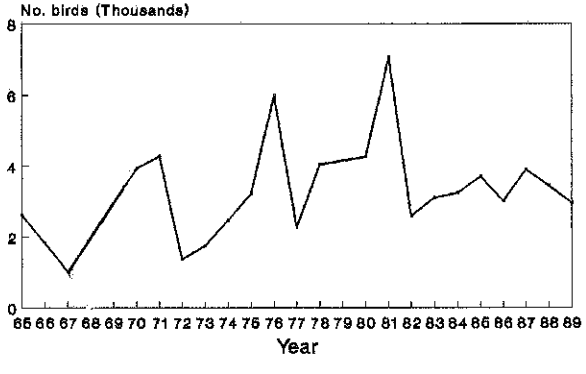
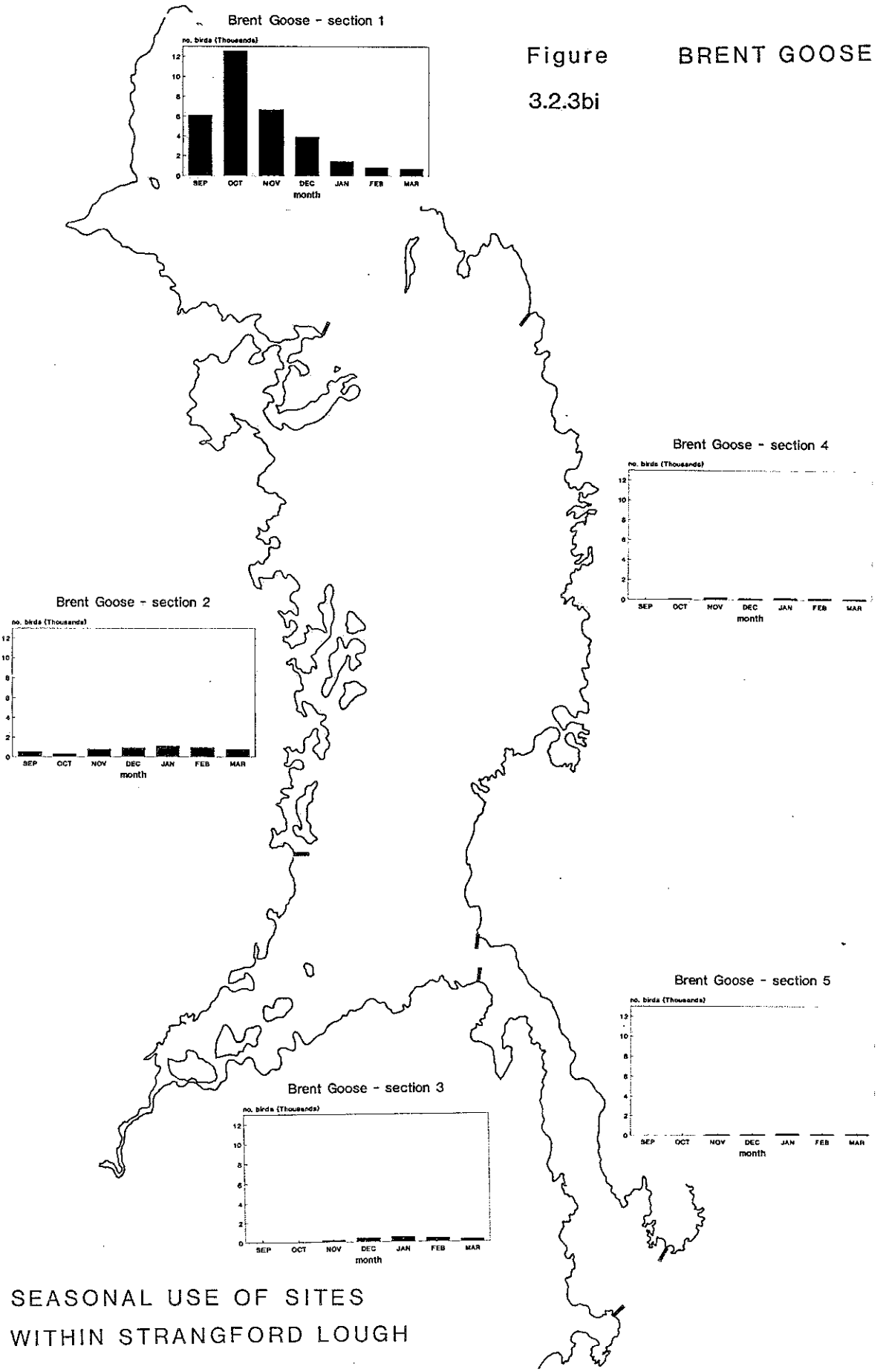


Figure 3.2.3bi

BRENT GOOSE



SEASONAL USE OF SITES
WITHIN STRANGFORD LOUGH

Figure 3.2.3bii BRENT GOOSE

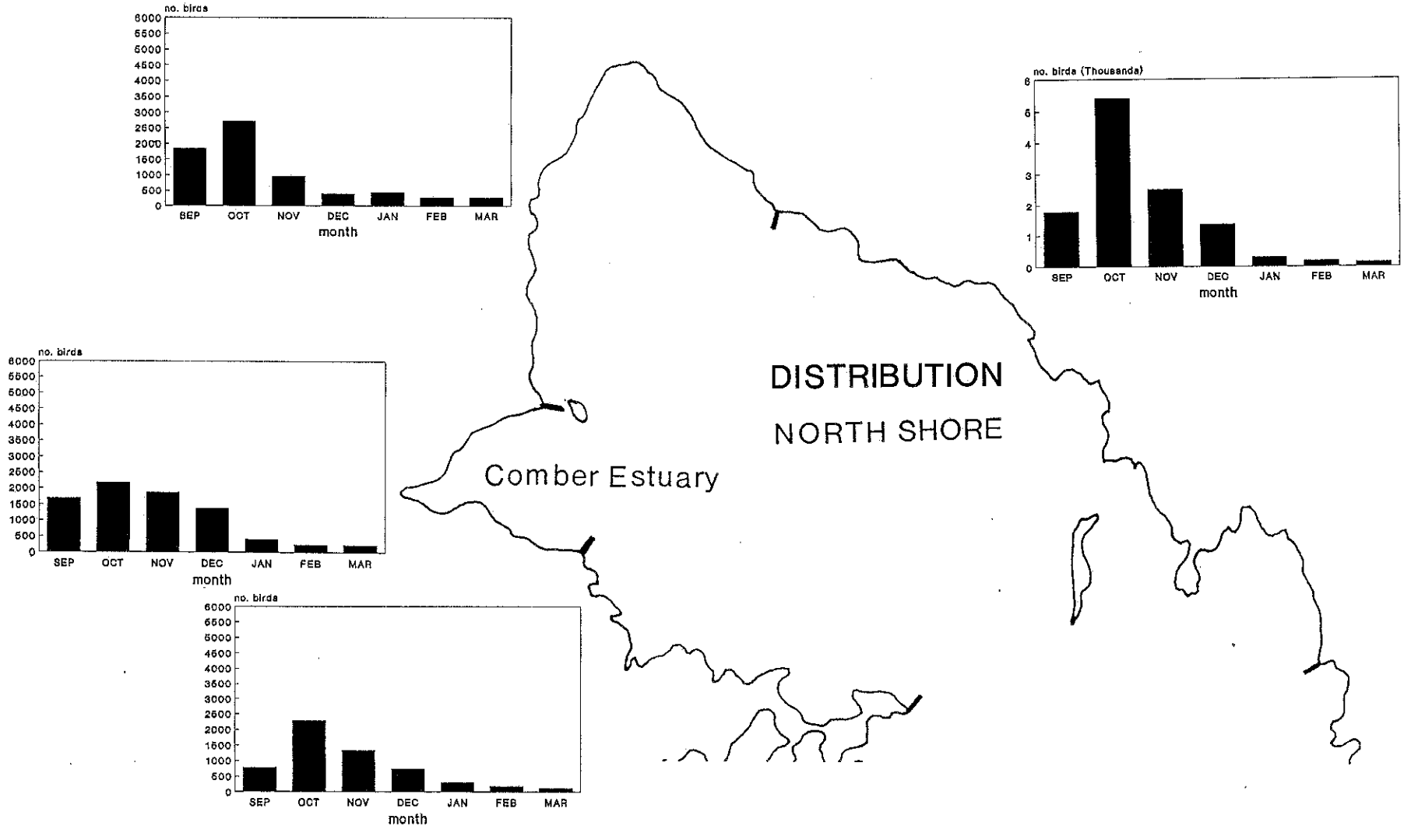
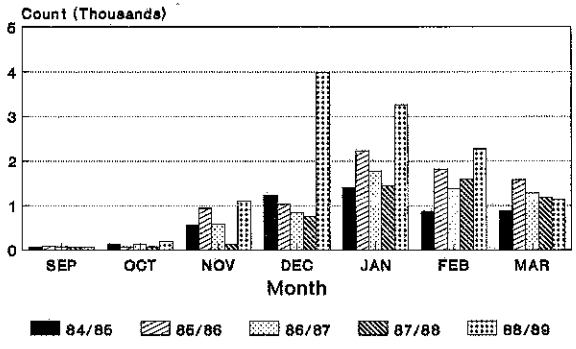
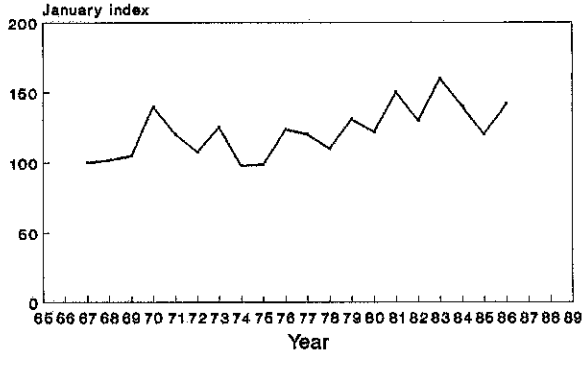


Figure 3.2.4 SHELDUCK

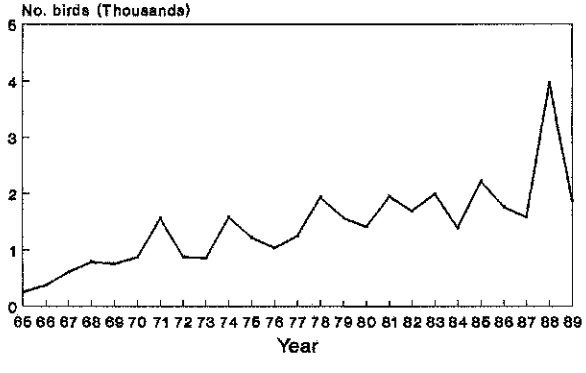
a. Seasonal abundance



e. Flyway index



c. Peak winter counts



d. January counts

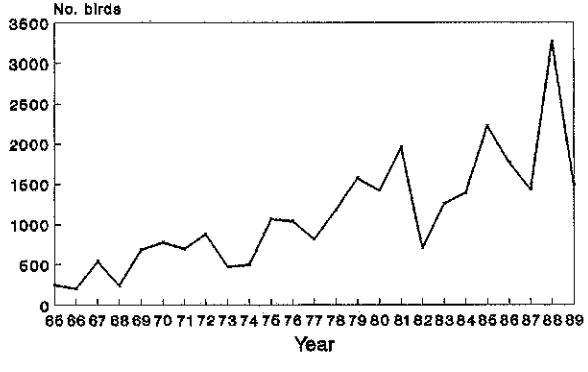
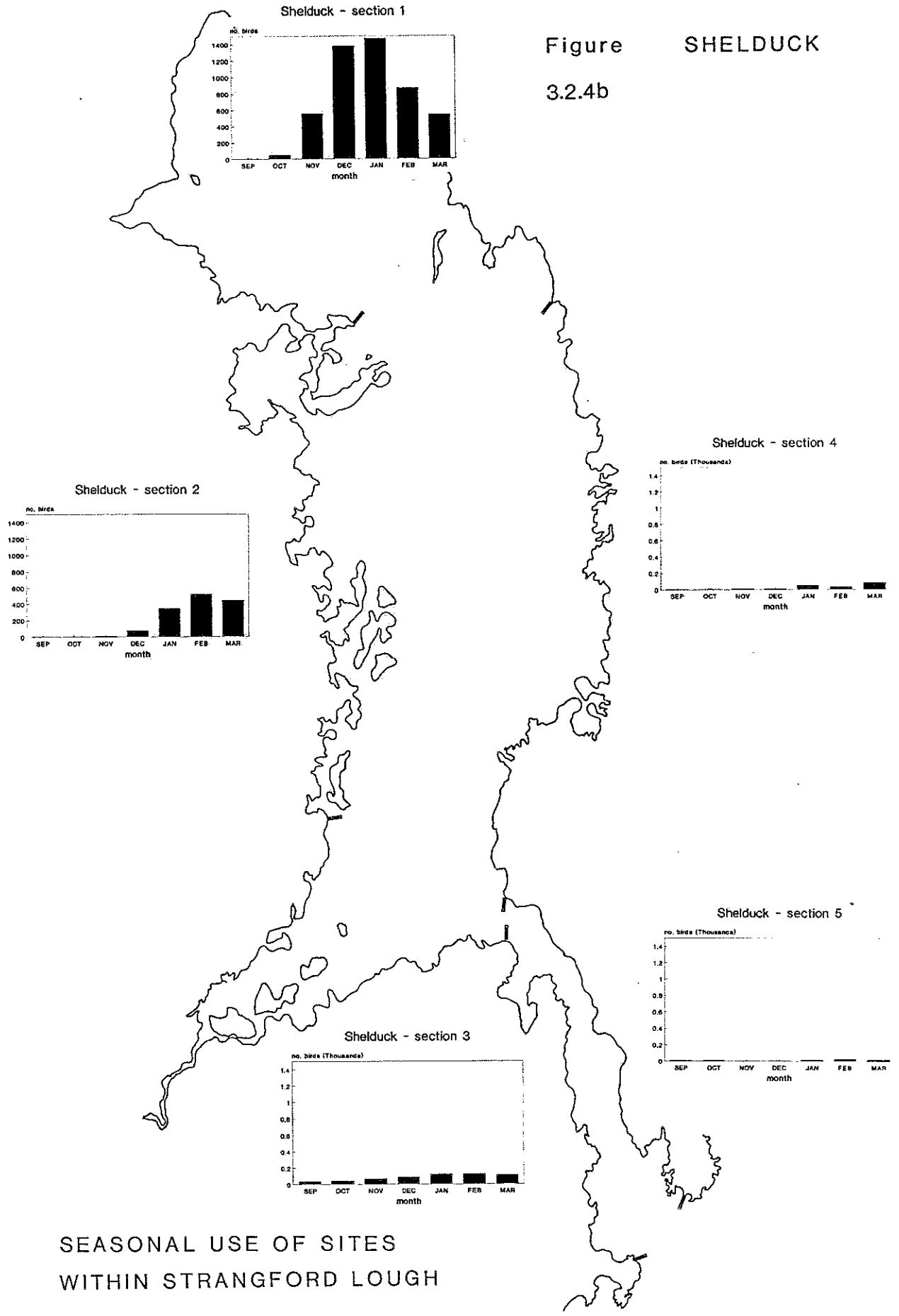


Figure 3.2.4b SHELDUCK



SEASONAL USE OF SITES
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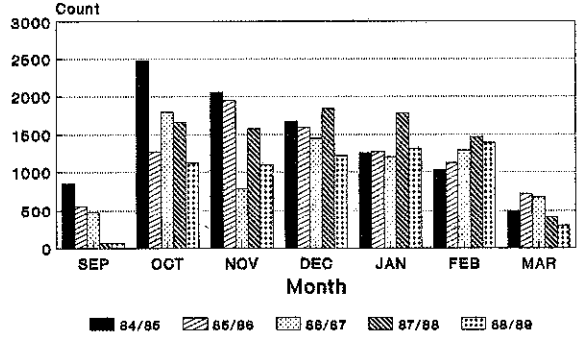
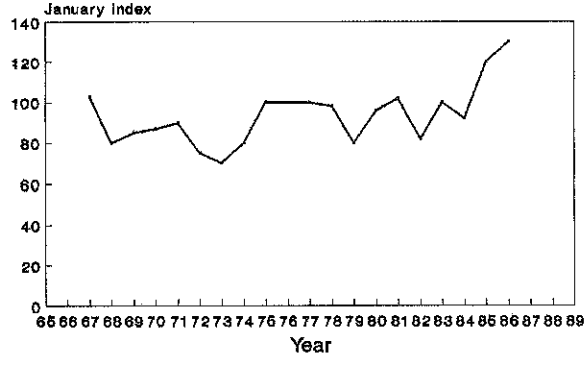
Figure 3.2.5 WIGEON

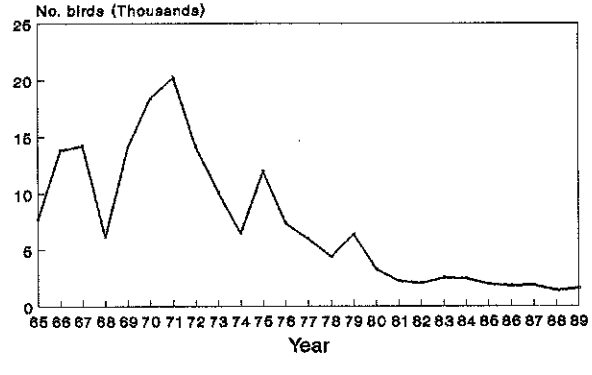
a. Seasonal abundance



e. Flyway index



c. Peak winter counts



d. January counts

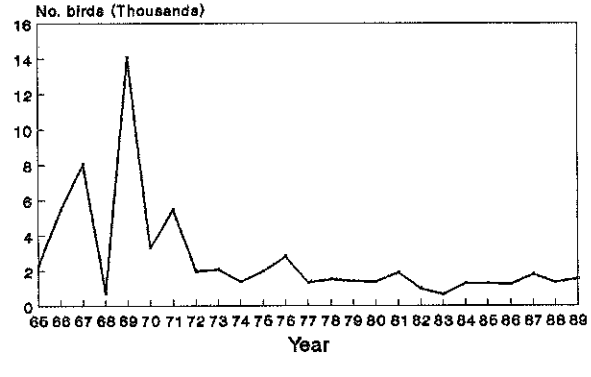
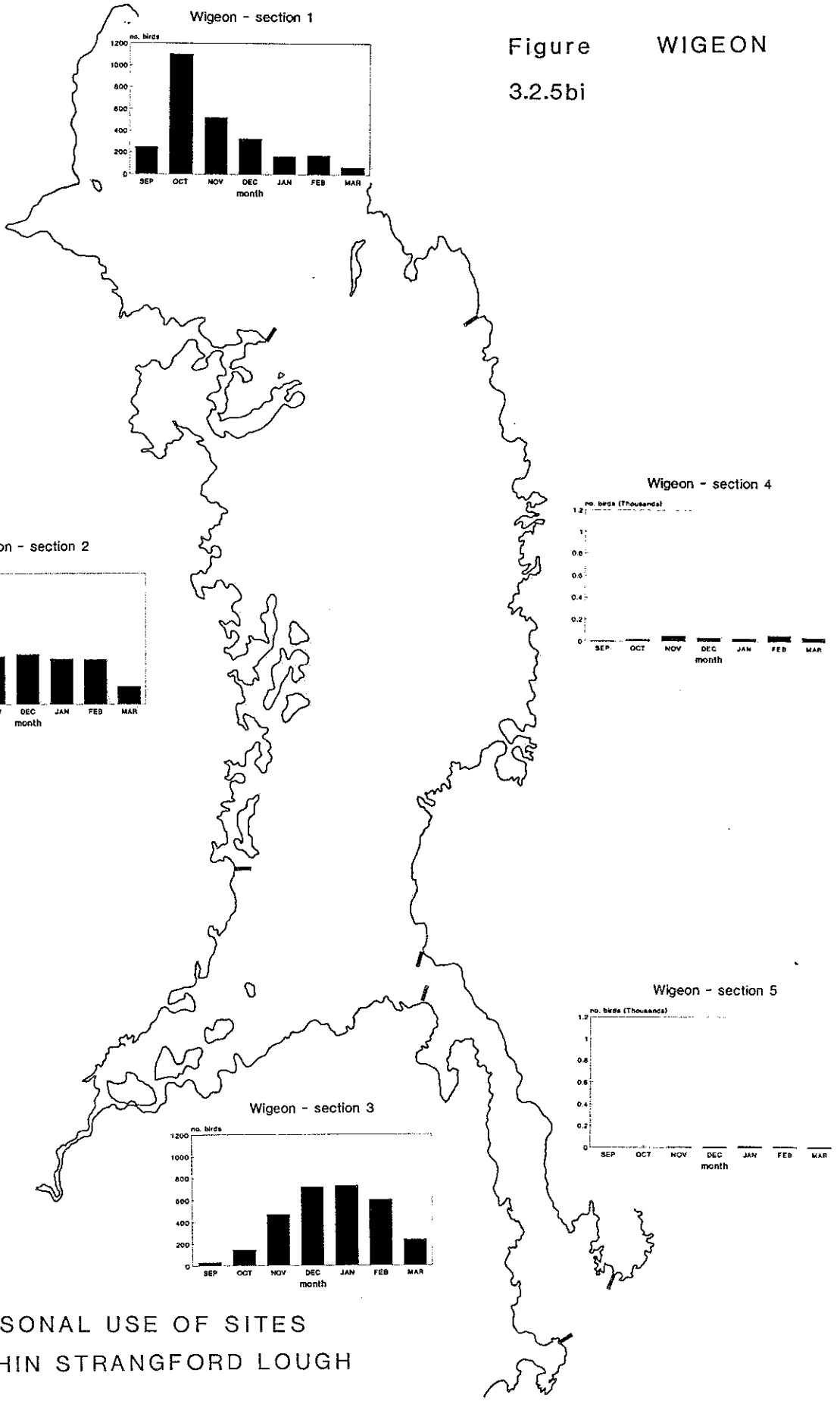


Figure 3.2.5bi WIGEON



SEASONAL USE OF SITES
WITHIN STRANGFORD LOUGH

Figure 3.2.5bii WIGEON

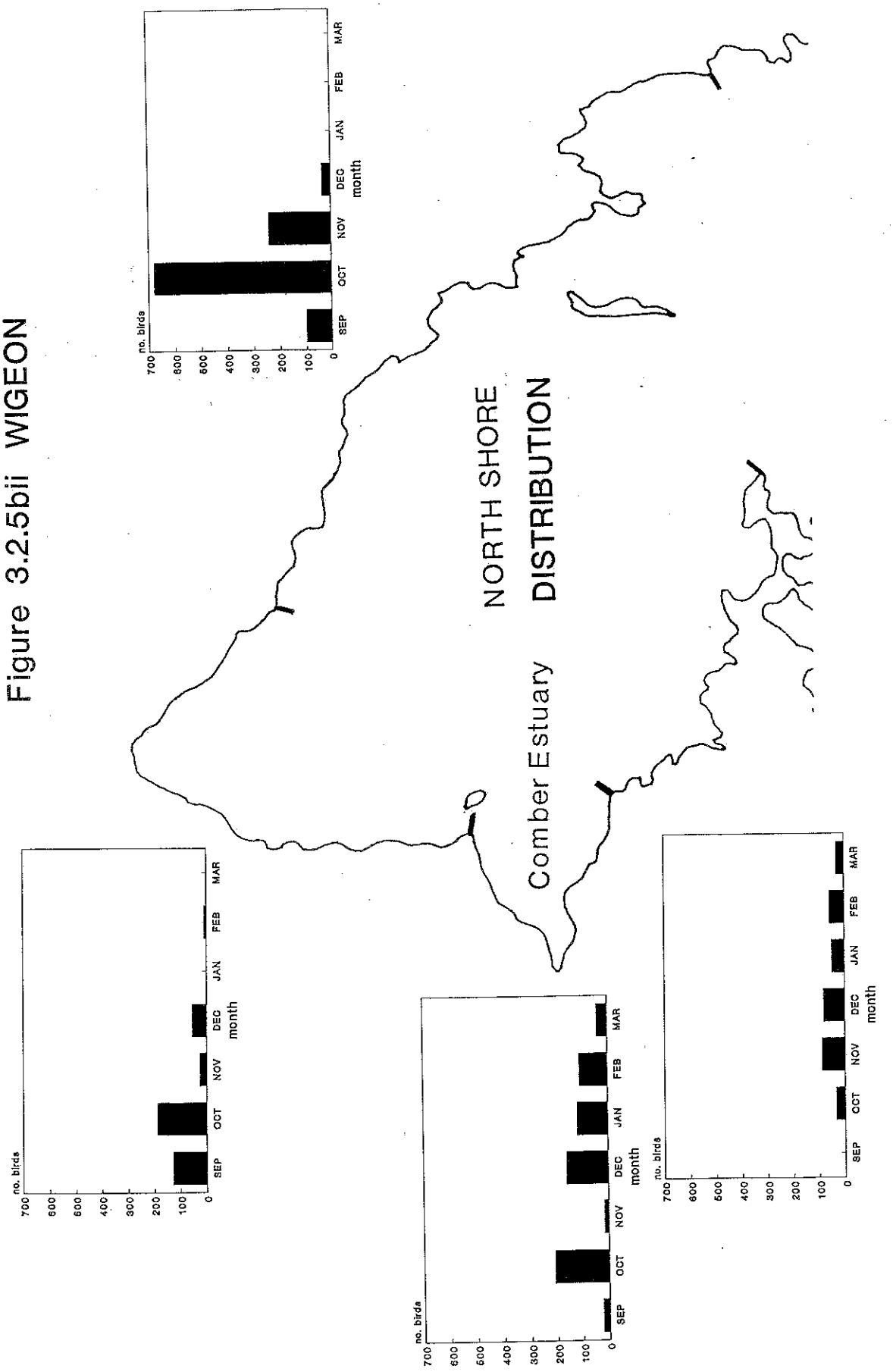


Figure 3.2.5biii WIGEON

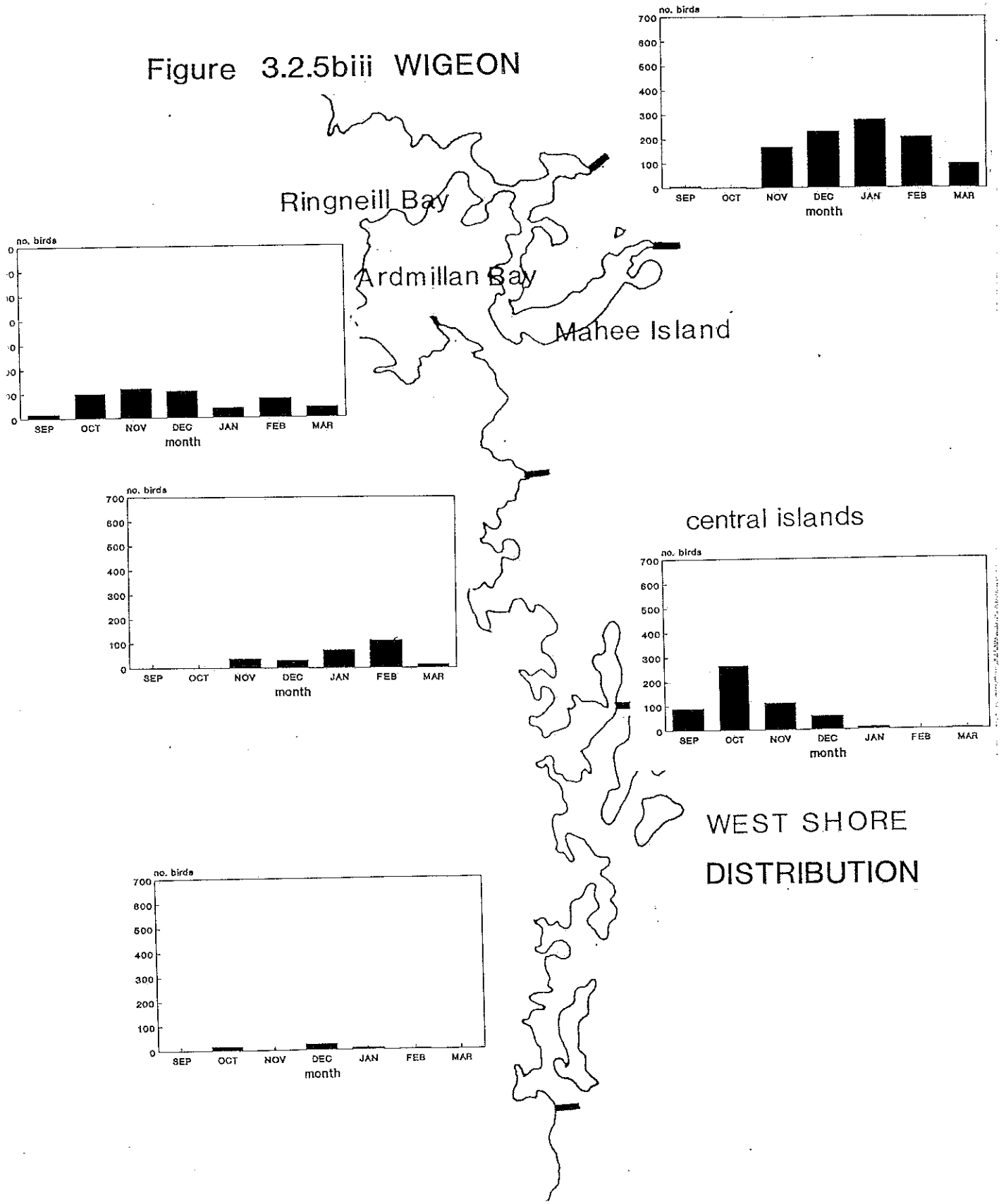


Figure 3.2.5biv WIGEON

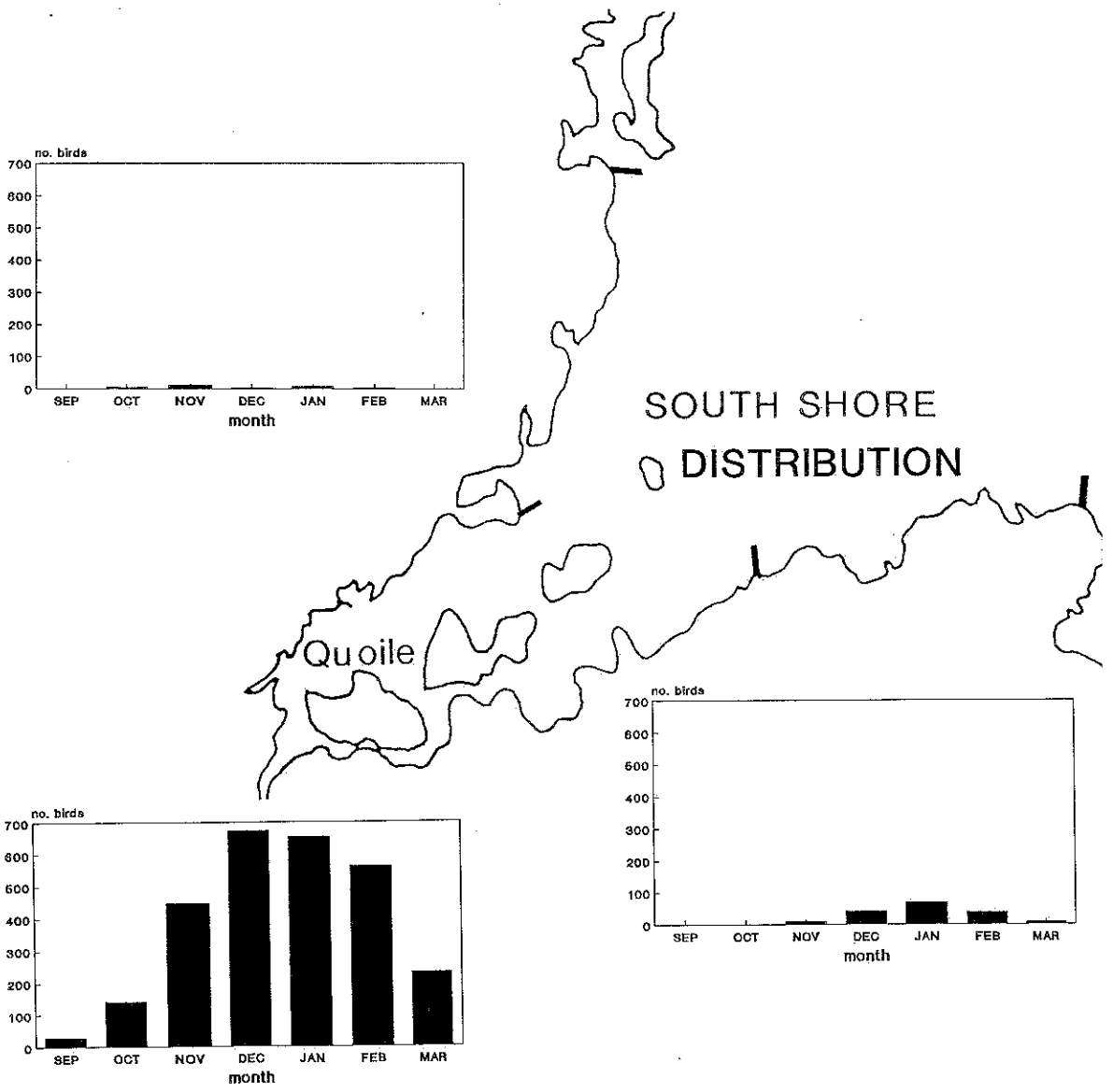
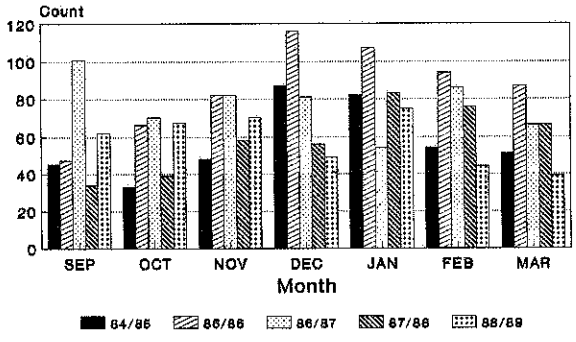
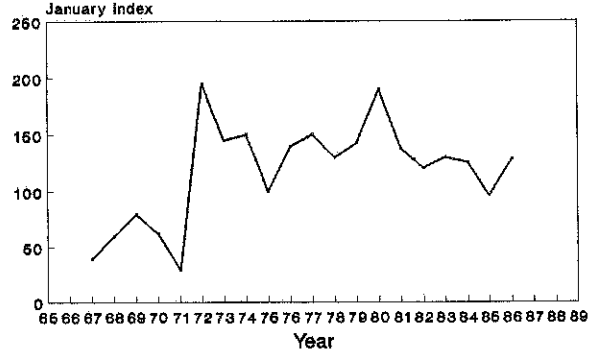


Figure 3.2.6 GADWALL

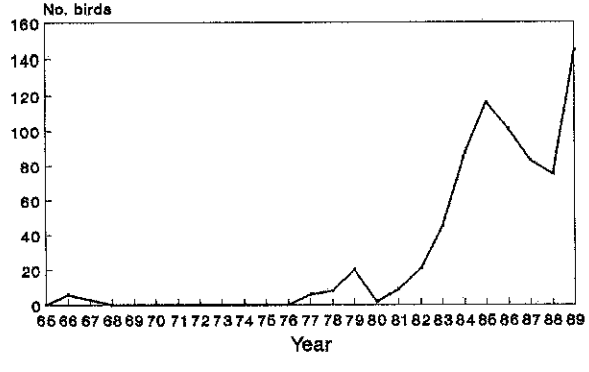
a. Seasonal abundance



e. Flyway index



c. Peak winter counts



d. January counts

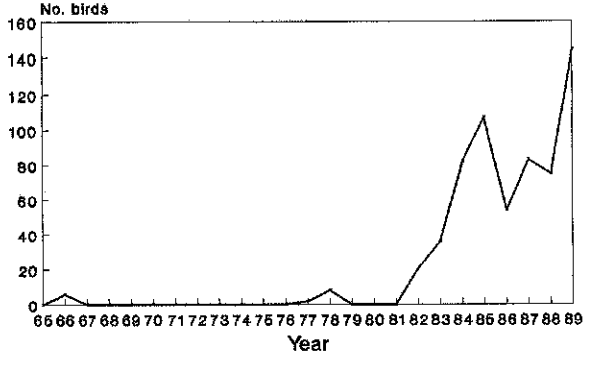
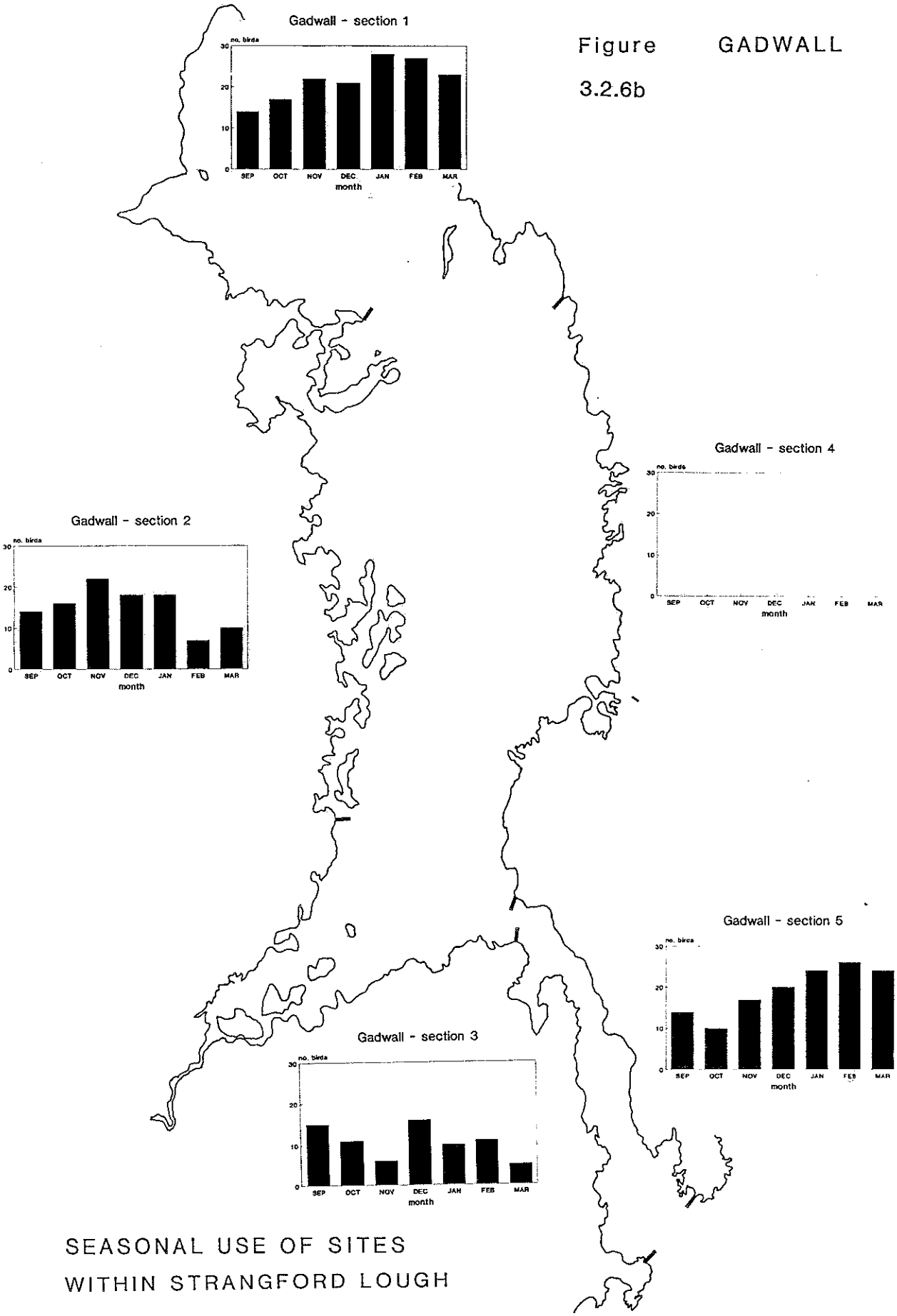


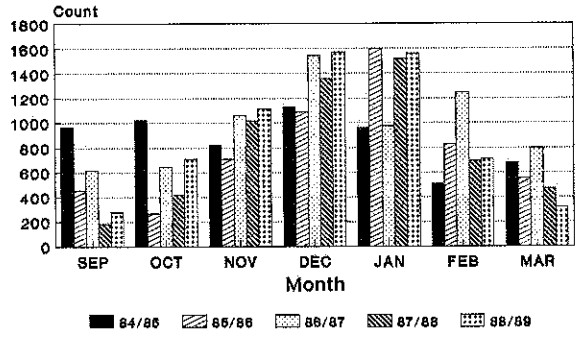
Figure 3.2.6b GADWALL



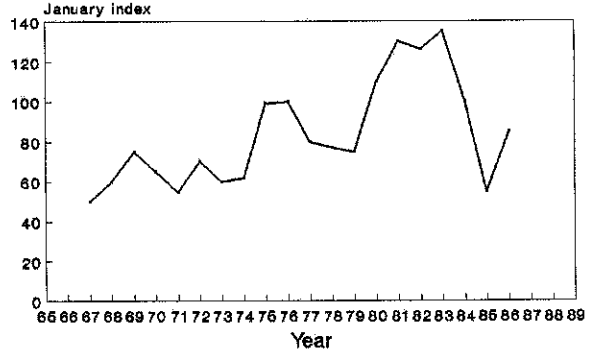
SEASONAL USE OF SITES
WITHIN STRANGFORD LOUGH

Figure 3.2.7 TEAL

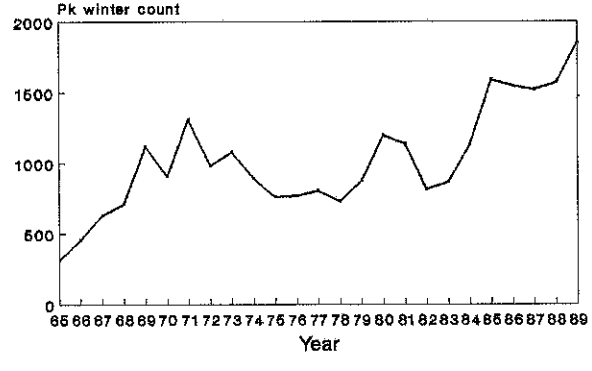
a. Seasonal abundance



e. Flyway index



c. Peak winter counts



d. January counts

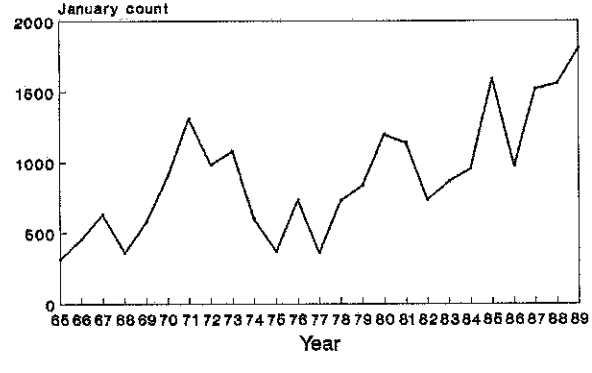
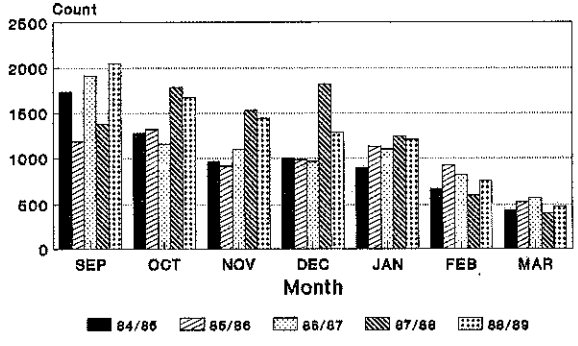
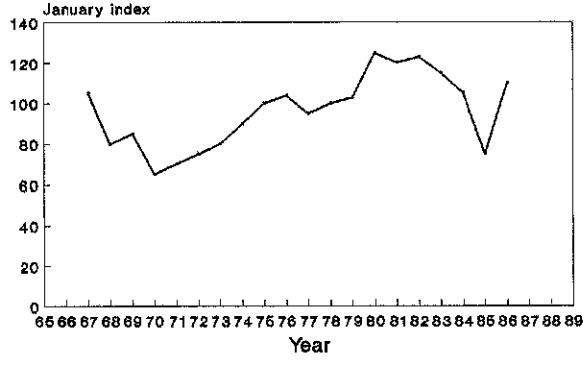


Figure 3.2.8 MALLARD

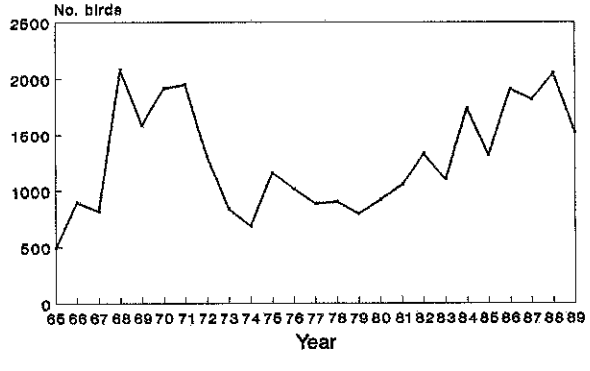
a. Seasonal abundance



e. Flyway index



c. Peak winter counts



d. January counts

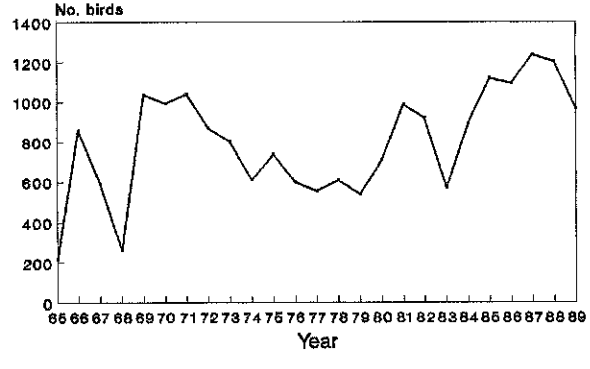
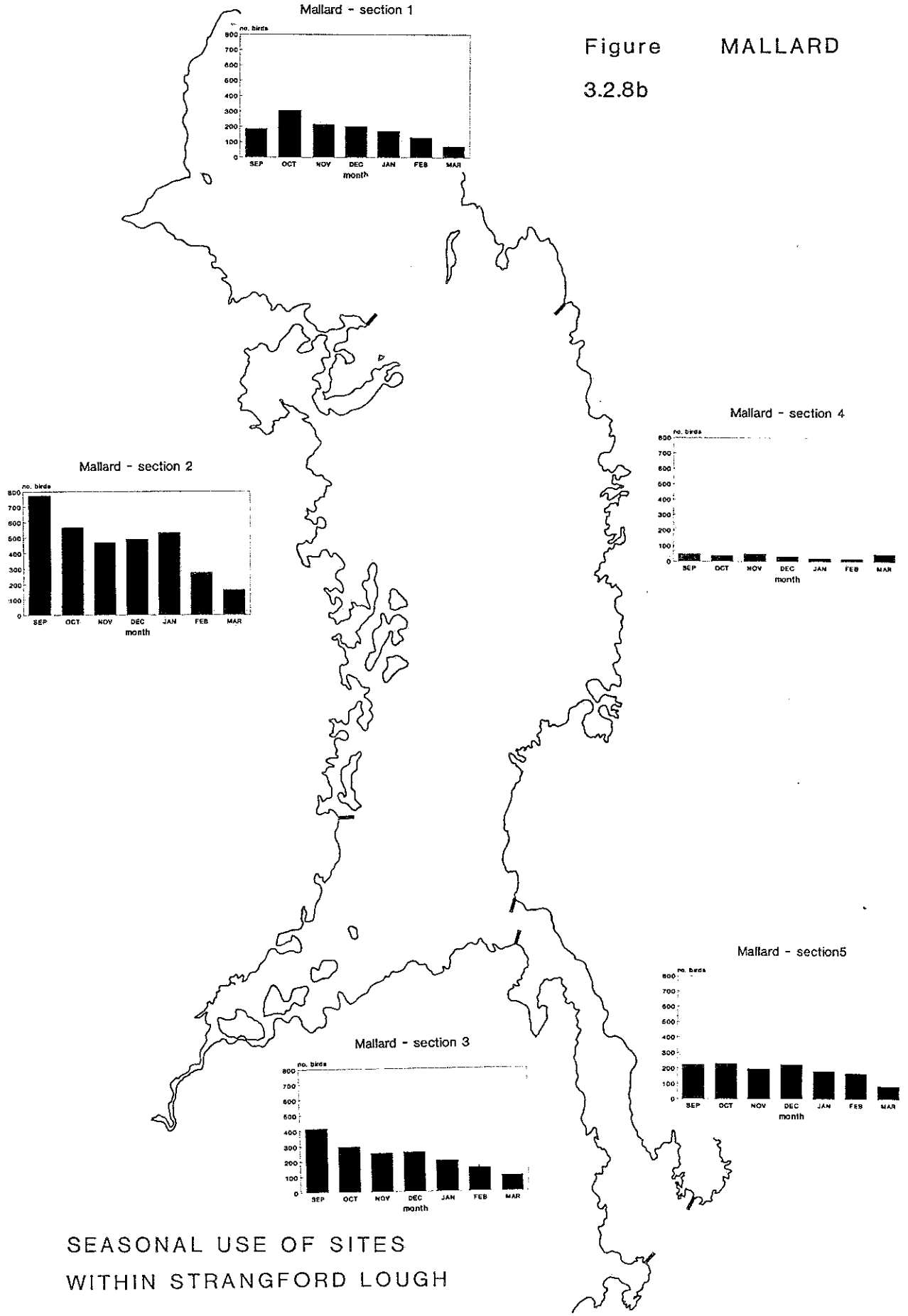


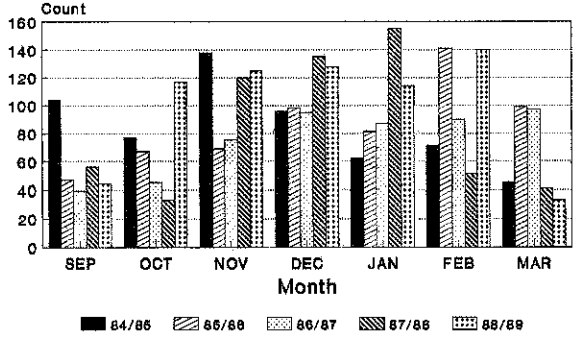
Figure 3.2.8b MALLARD



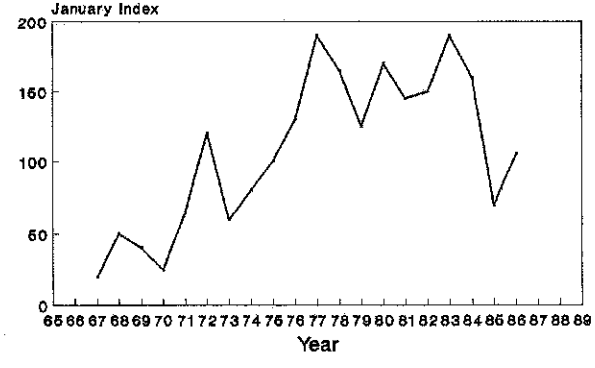
SEASONAL USE OF SITES
WITHIN STRANGFORD LOUGH

Figure 3.2.9 SHOVELER

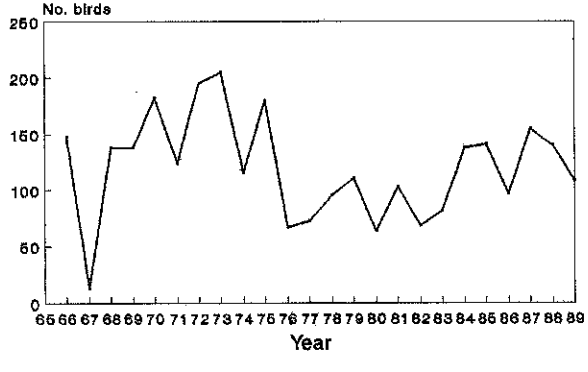
a. Seasonal abundance



e. Flyway index



c. Peak winter counts



d. January counts

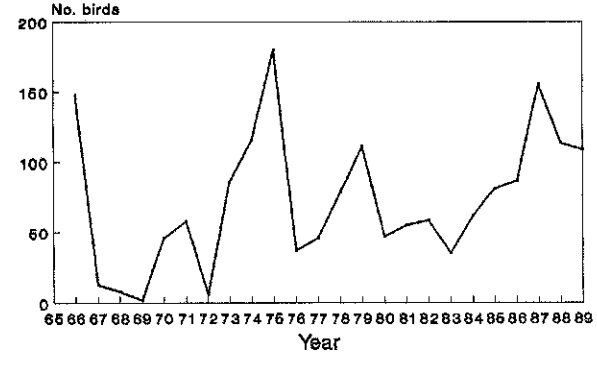
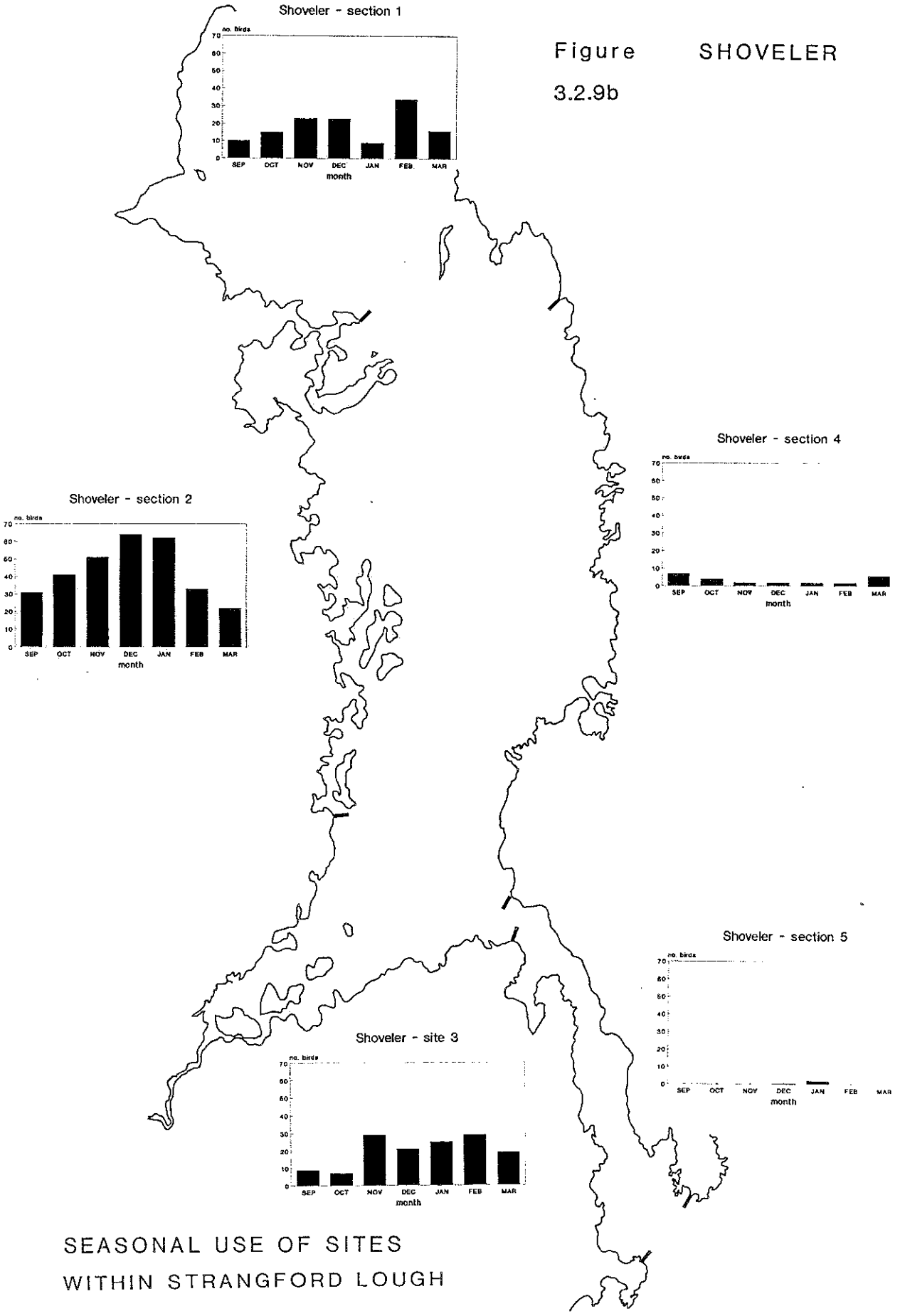


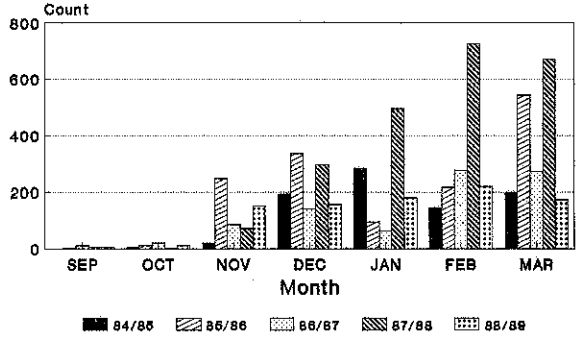
Figure 3.2.9b SHOVELER



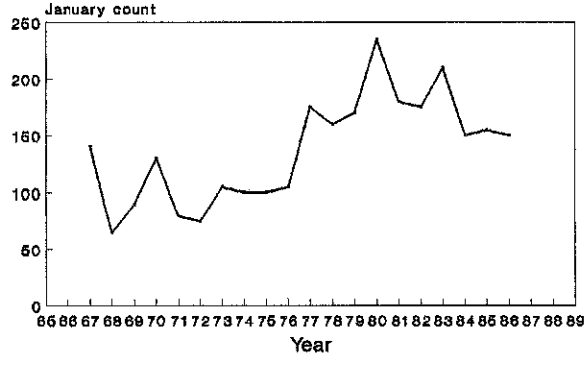
SEASONAL USE OF SITES WITHIN STRANGFORD LOUGH

Figure 3.2.10 GOLDENEYE

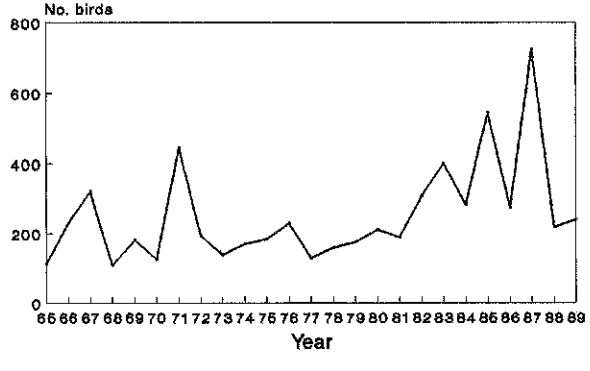
a. Seasonal abundance



e. Flyway index



c. Peak winter counts



d. January counts

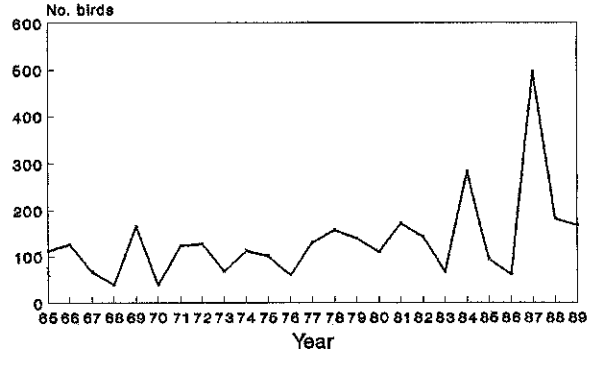
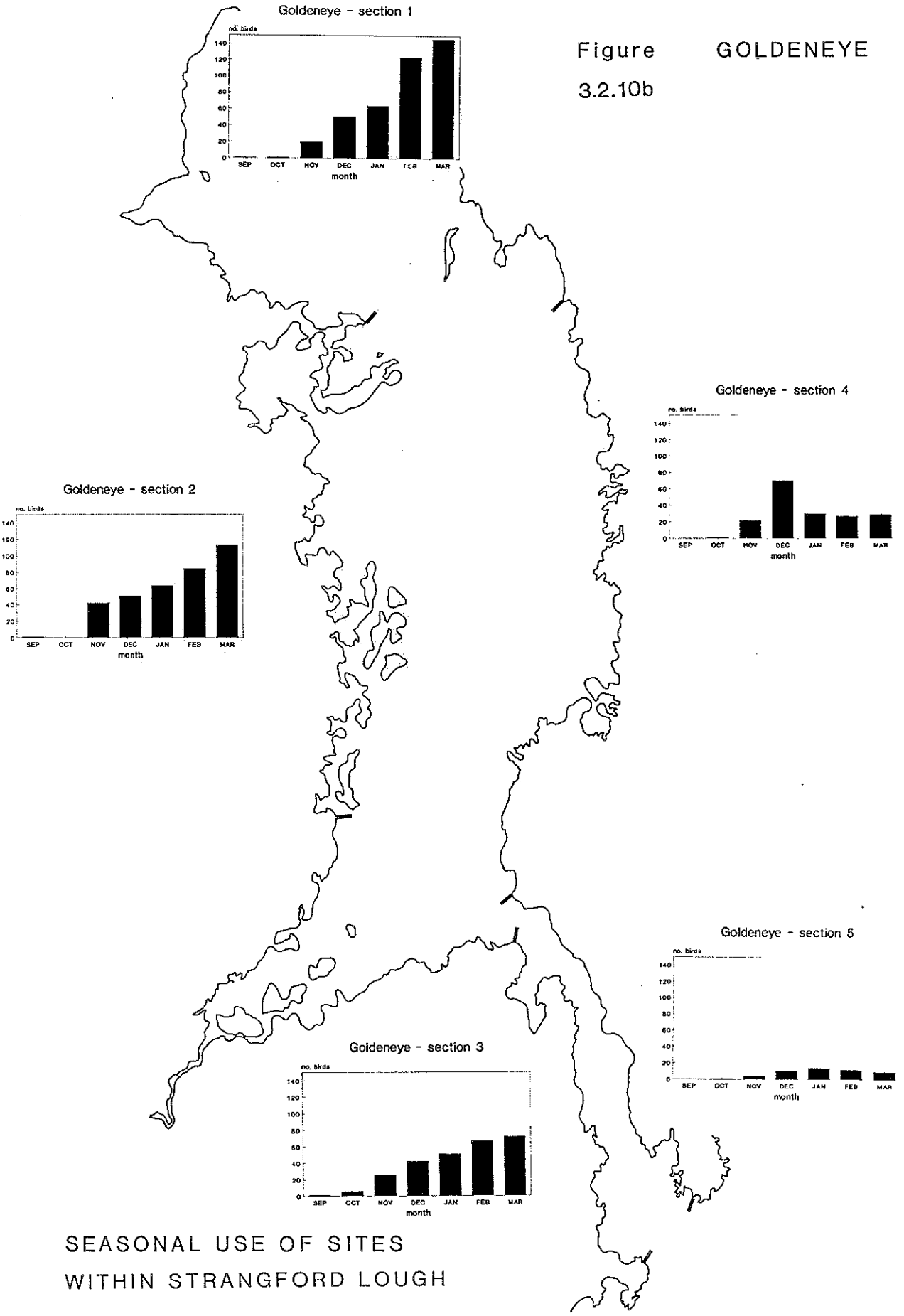


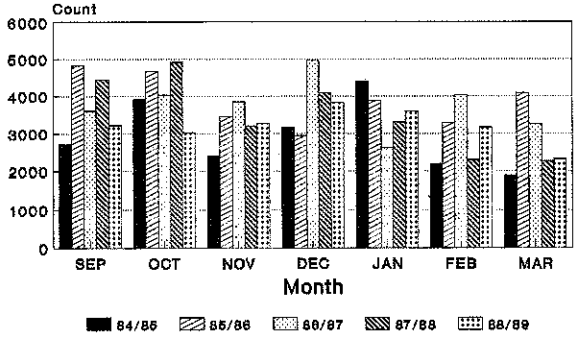
Figure 3.2.10b GOLDENEYE



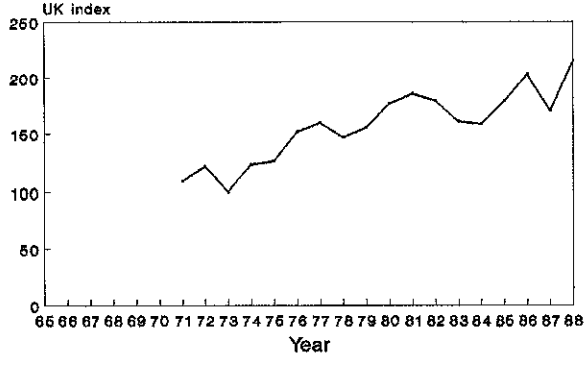
SEASONAL USE OF SITES
WITHIN STRANGFORD LOUGH

Figure 3.2.11 OYSTERCATCHER

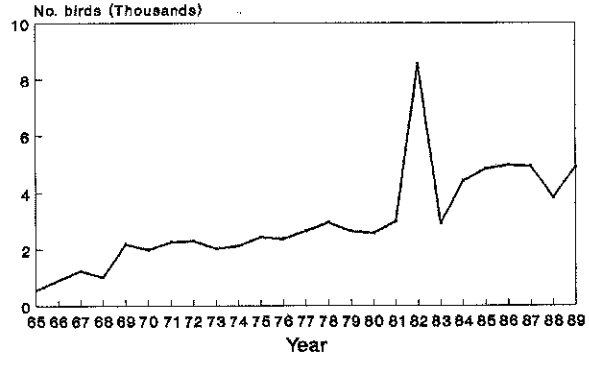
a. Seasonal abundance



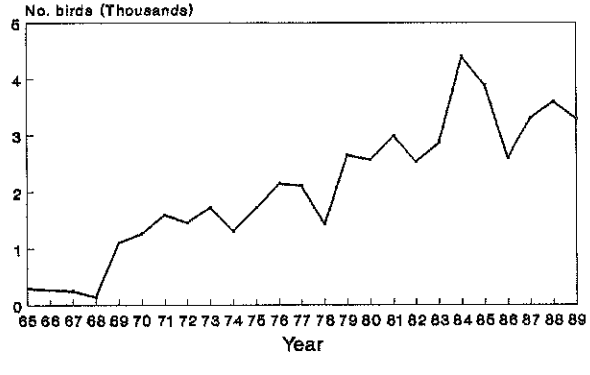
e. UK January index



c. Peak winter counts



d. January counts



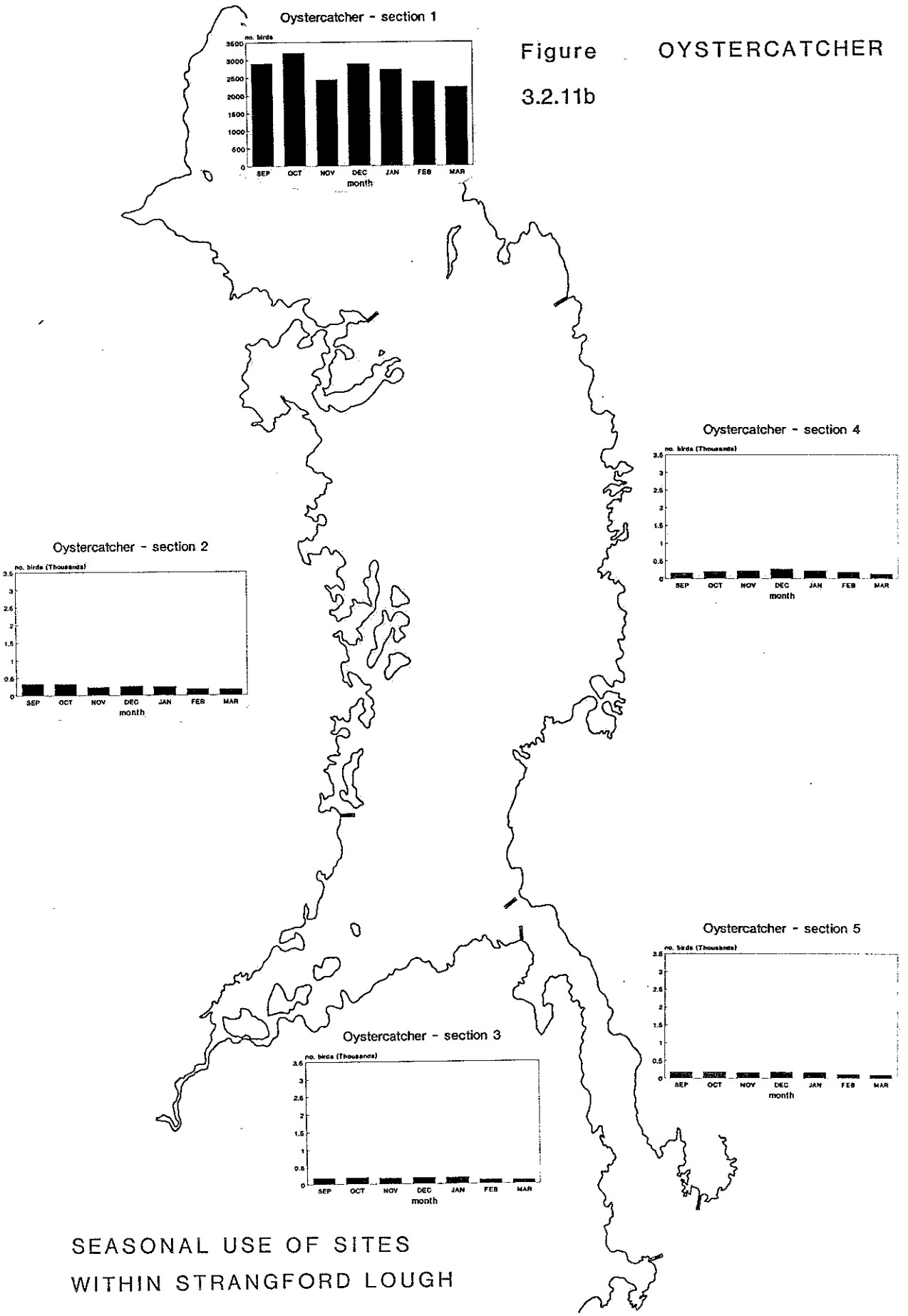
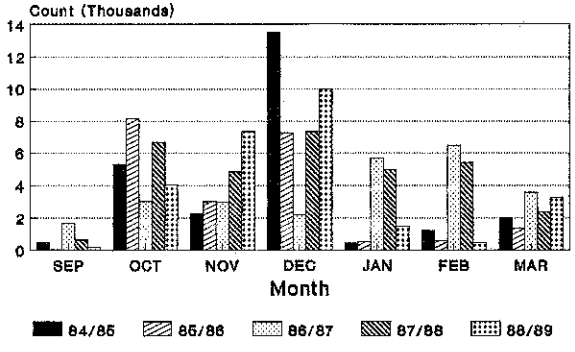


Figure 3.2.11b OYSTERCATCHER

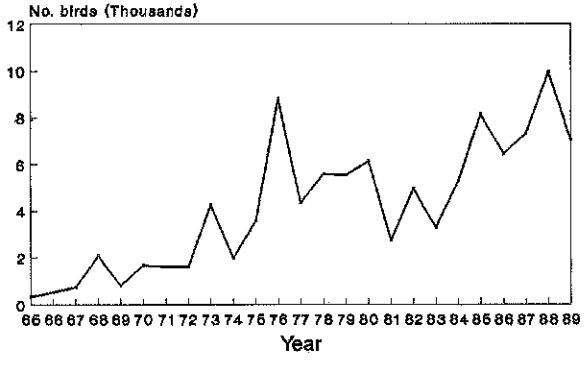
SEASONAL USE OF SITES WITHIN STRANGFORD LOUGH

Figure 3.2.12 GOLDEN PLOVER

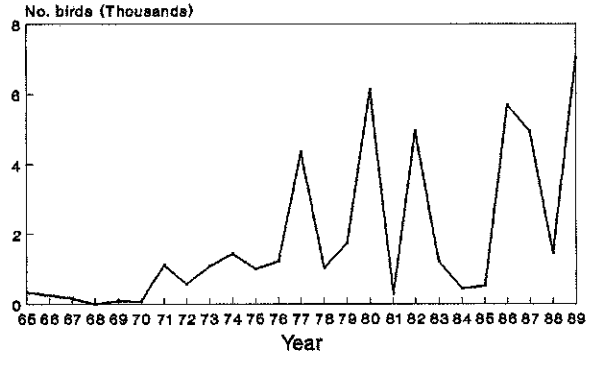
a. Seasonal abundance



c. Peak winter counts



d. January counts



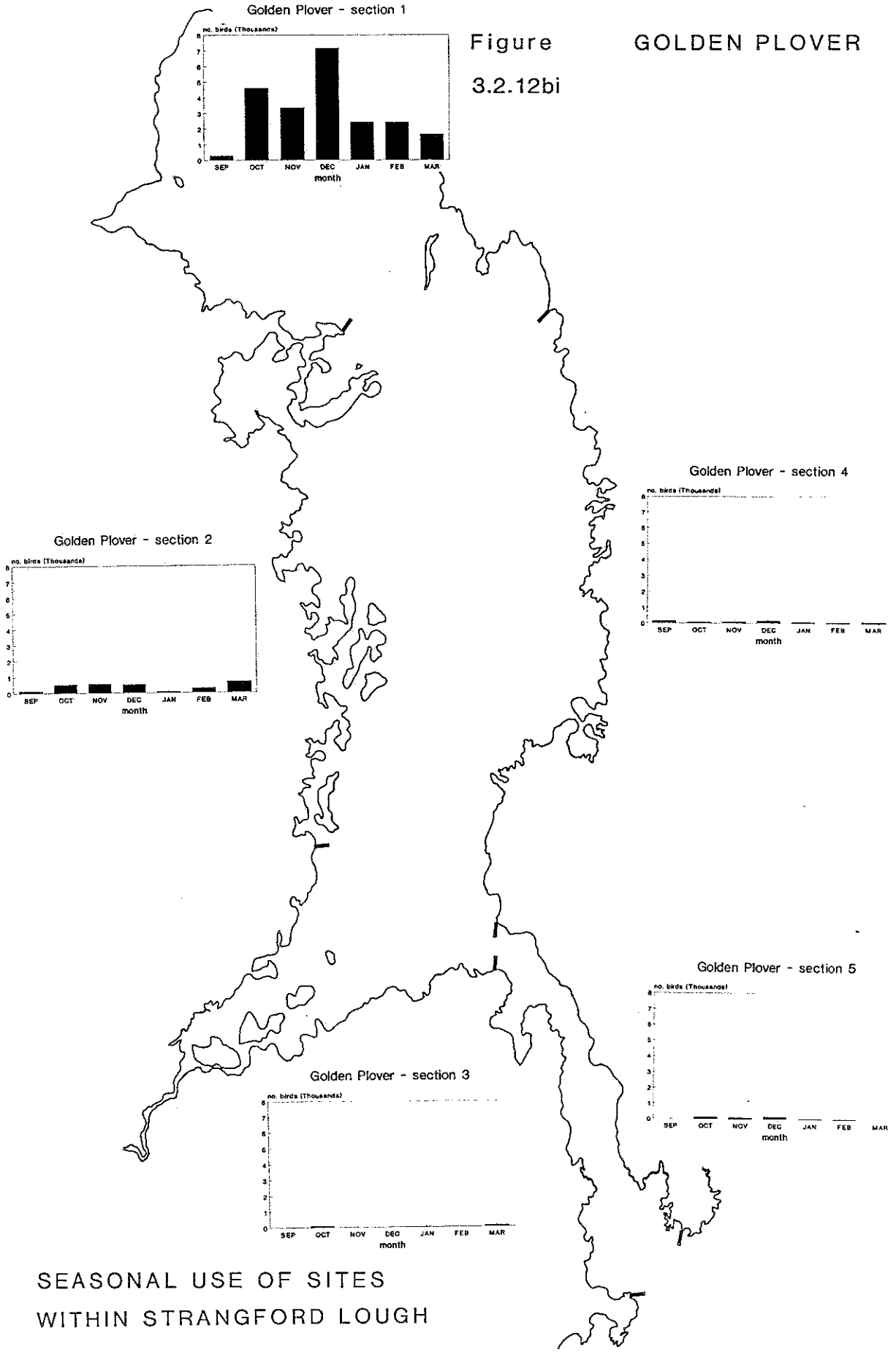


Figure 3.2.12bi GOLDEN PLOVER

SEASONAL USE OF SITES WITHIN STRANGFORD LOUGH

Figure 3.2.12bii GOLDEN PLOVER

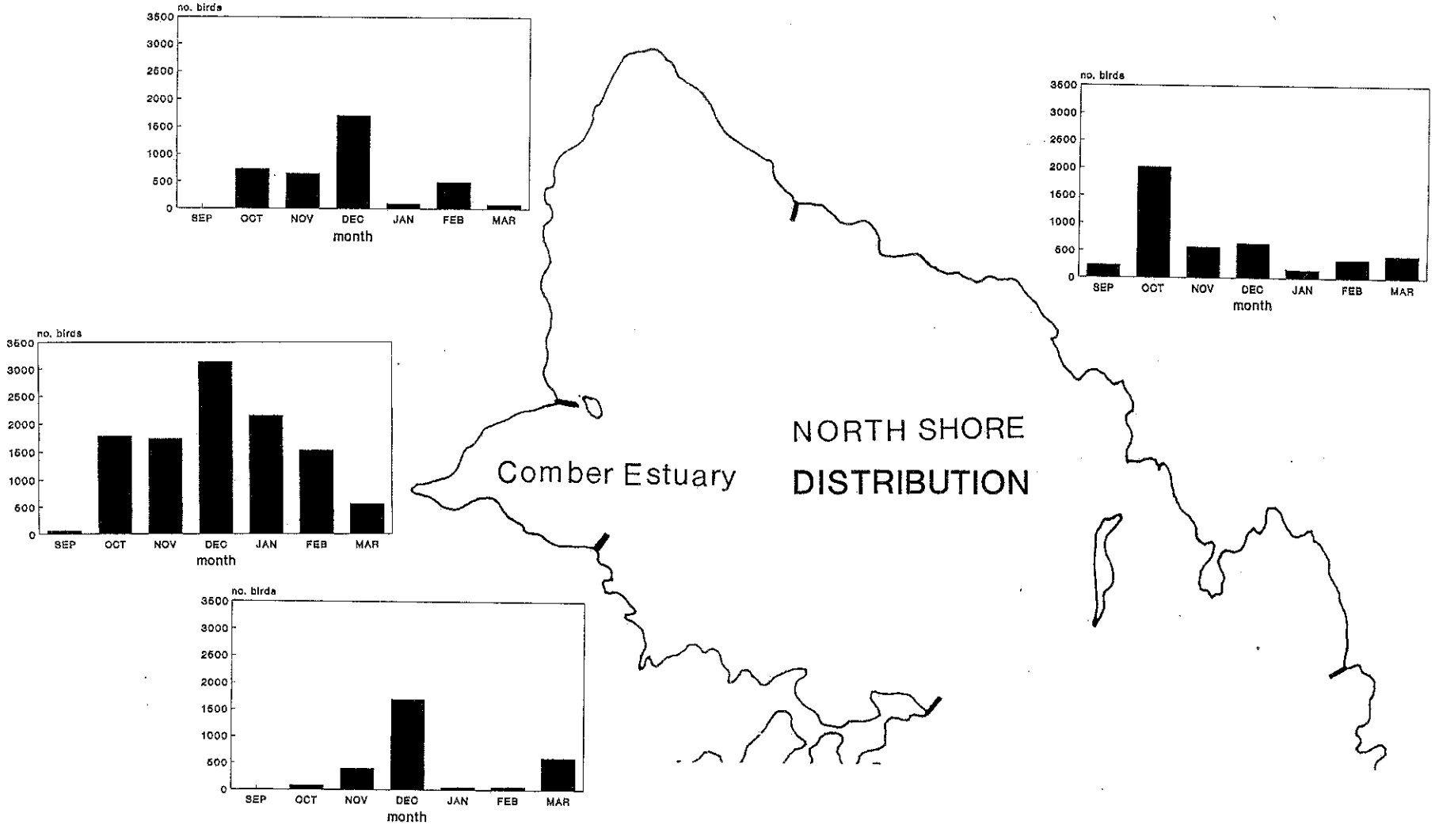
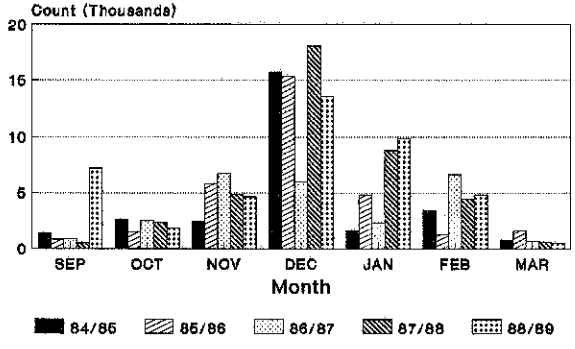
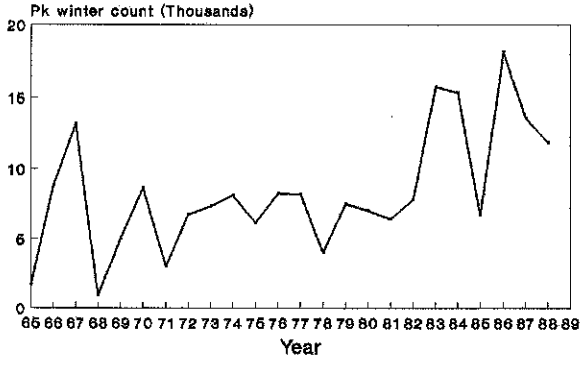


Figure 3.2.13 LAPWING

a. Seasonal abundance



c. Peak winter counts



d. January counts

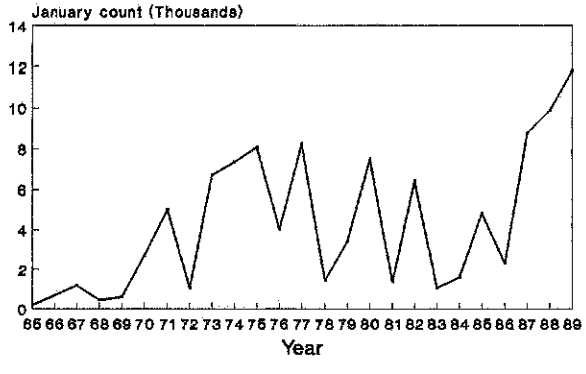
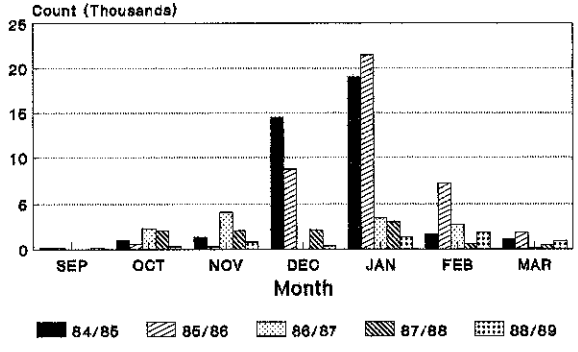
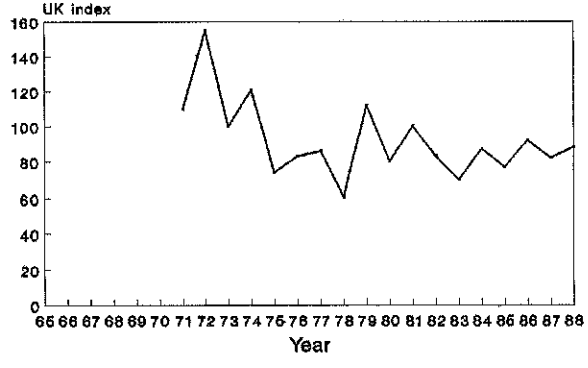


Figure 3.2.14 KNOT

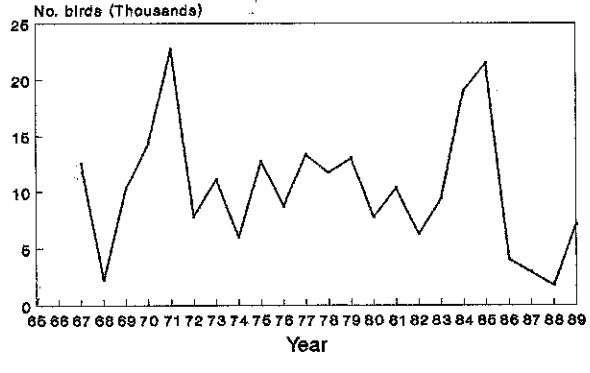
a. Seasonal abundance



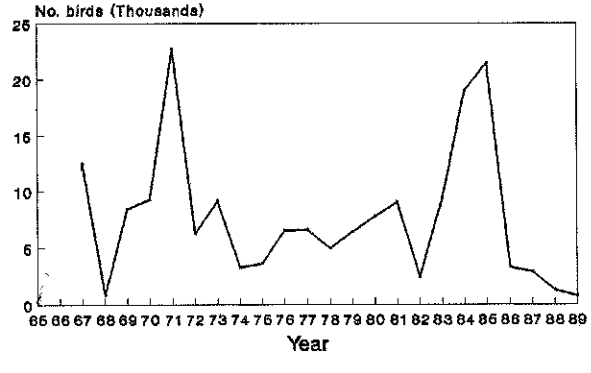
e. UK January index



c. Peak winter counts



d. January counts



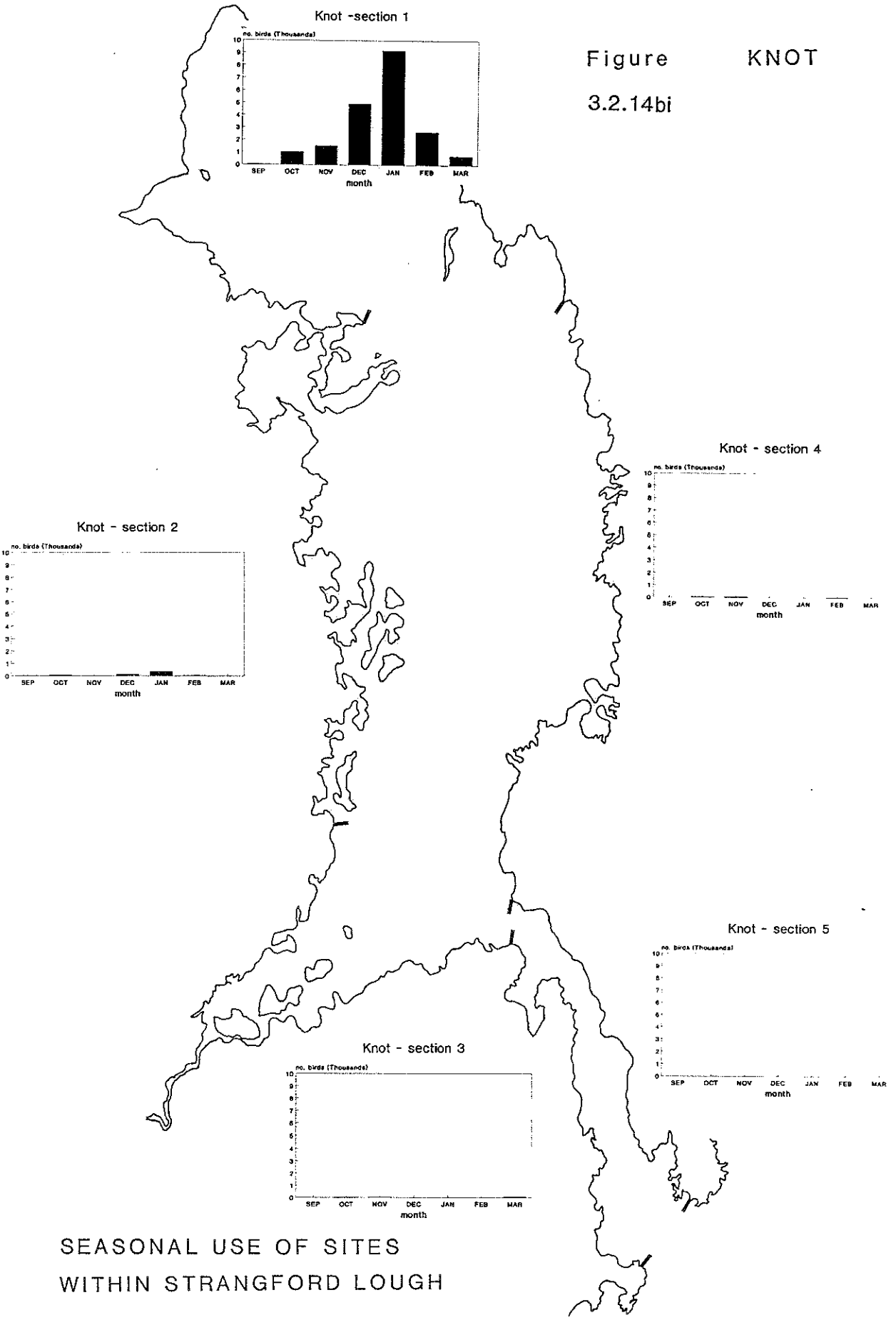
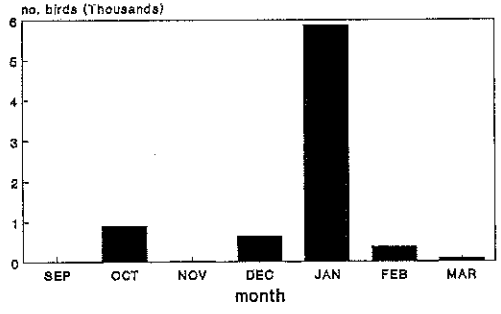
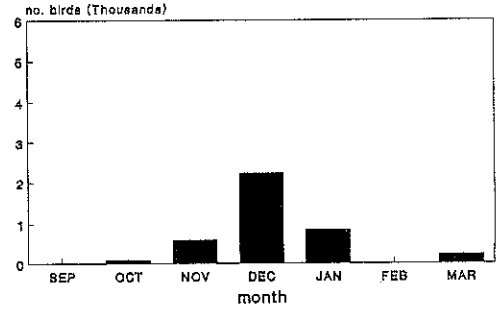


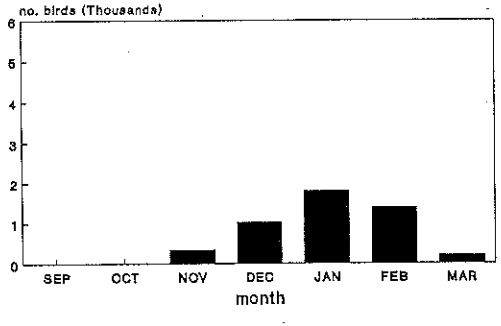
Figure KNOT 3.2.14bi

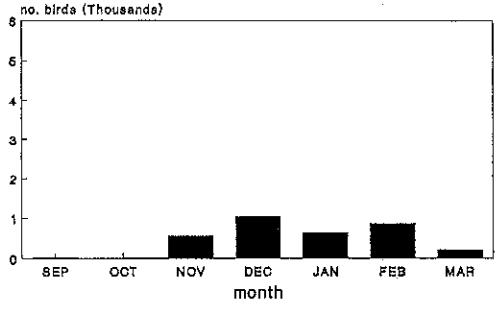
SEASONAL USE OF SITES WITHIN STRANGFORD LOUGH

Figure 3.2.14bii KNOT









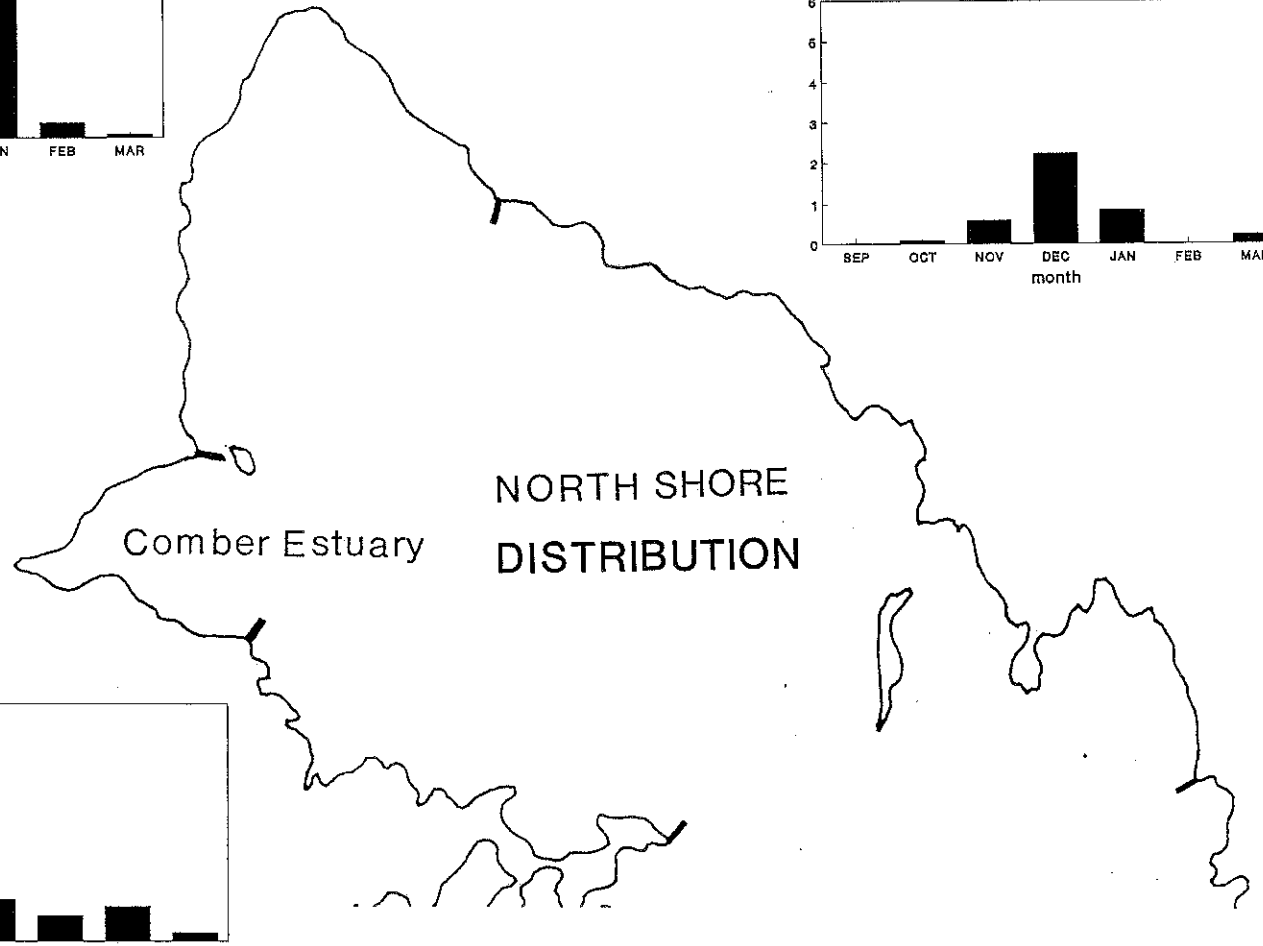
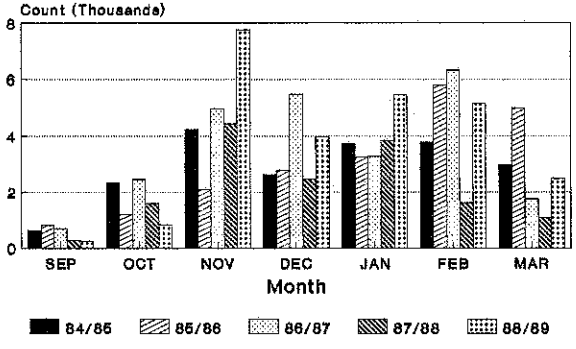
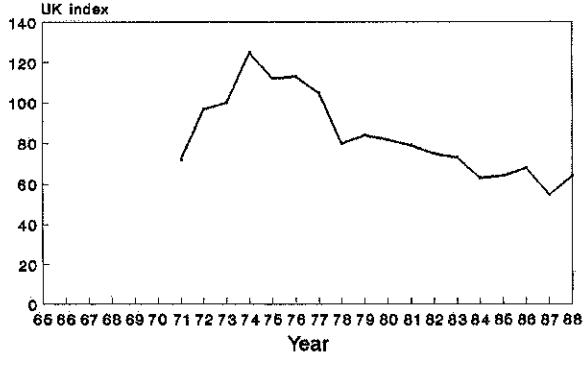


Figure 3.2.15 DUNLIN

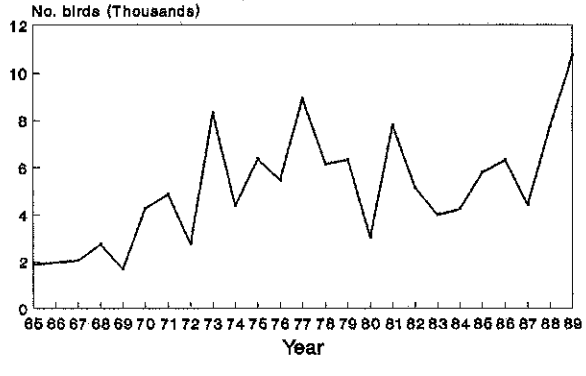
a. Seasonal abundance



e. UK January index



c. Peak winter counts



d. January counts

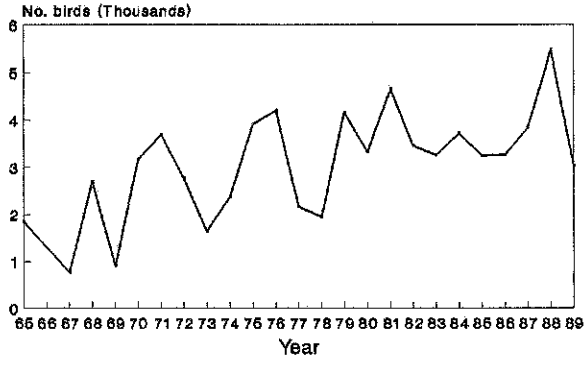
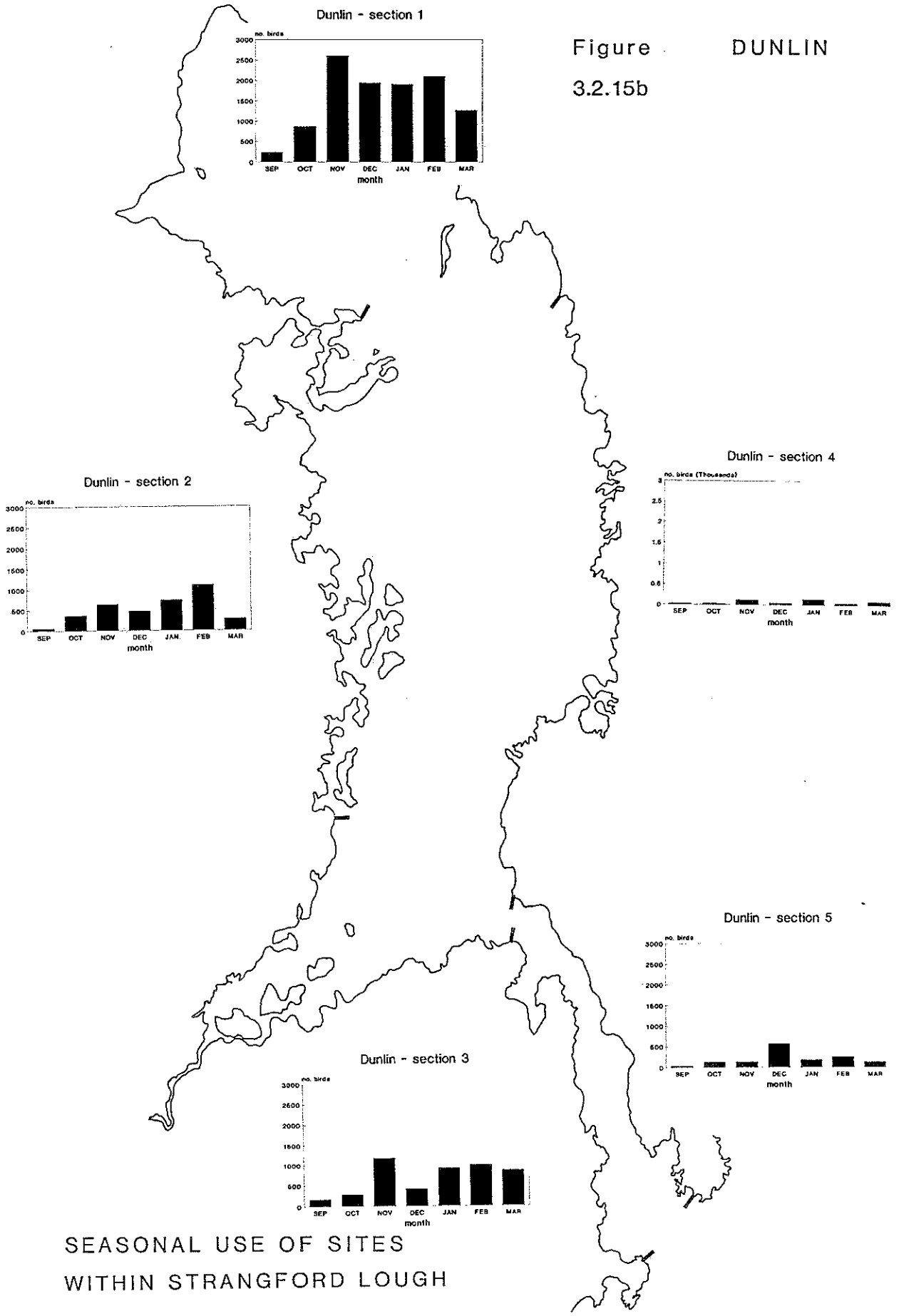


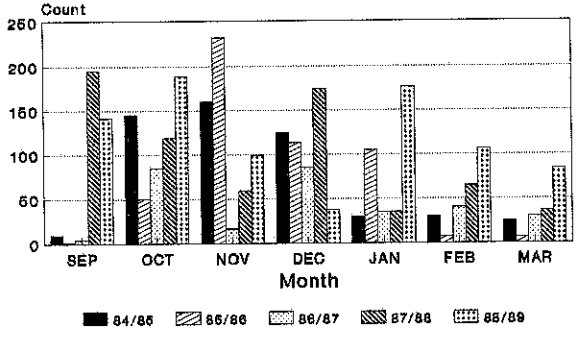
Figure 3.2.15b DUNLIN



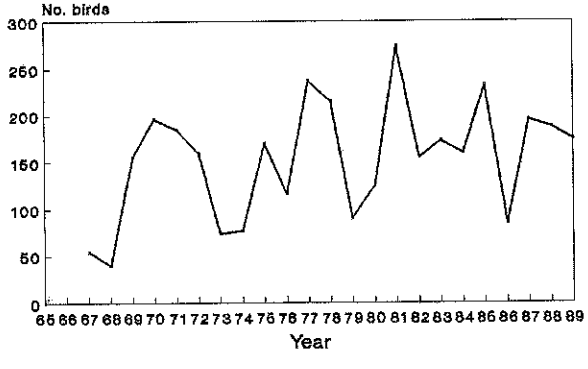
SEASONAL USE OF SITES
WITHIN STRANGFORD LOUGH

Figure 3.2.16 BLACK-TAILED GODWIT

a. Seasonal abundance



c. Peak winter counts



d. January counts

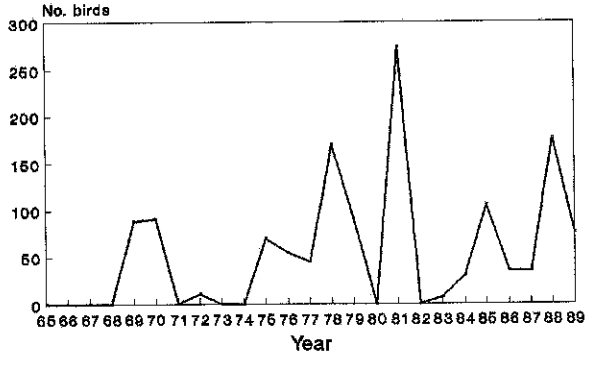
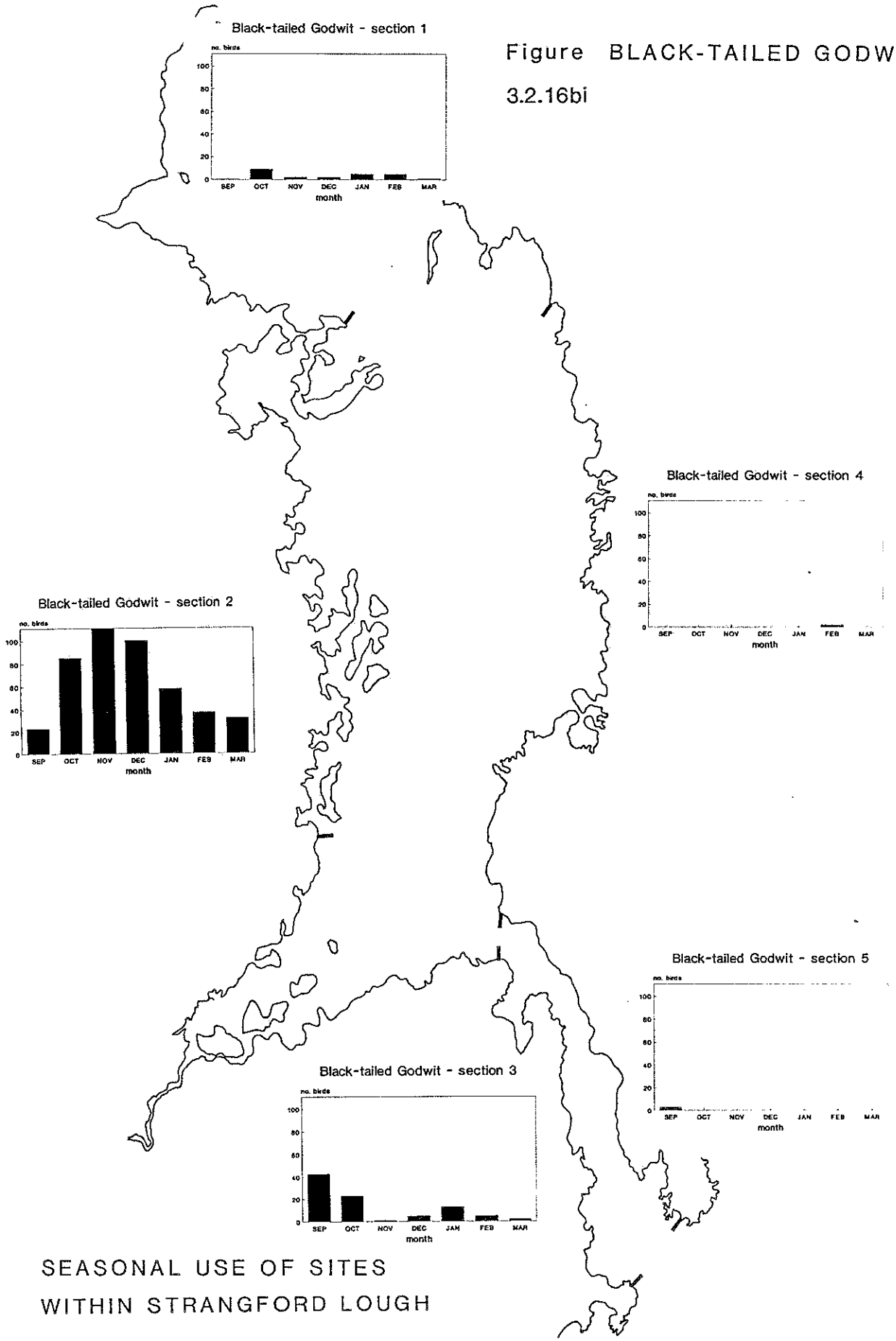
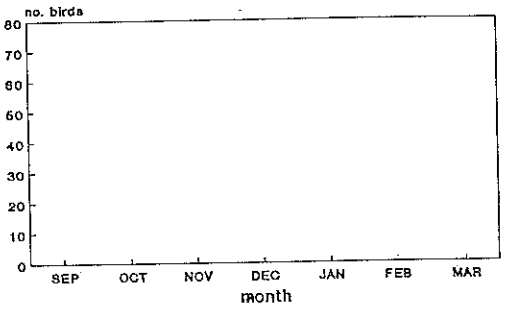


Figure BLACK-TAILED GODWIT
3.2.16bi

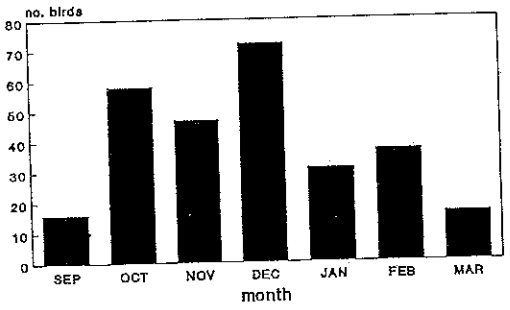


SEASONAL USE OF SITES
WITHIN STRANGFORD LOUGH

Figure
3.2.16bii BLACK-TAILED GODWIT

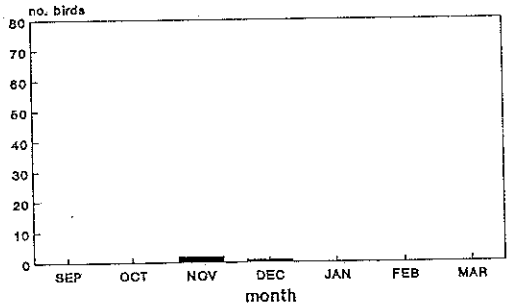


Ringneill Bay

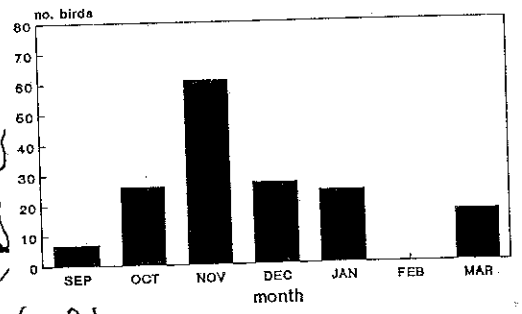


Ardmillan Bay

Mahee Island



central islands



WEST SHORE
DISTRIBUTION

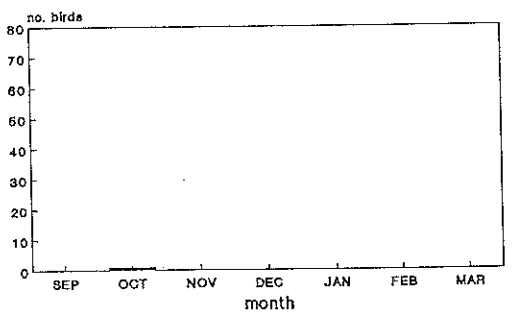
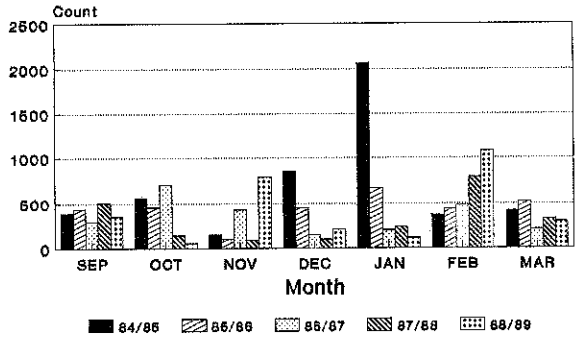
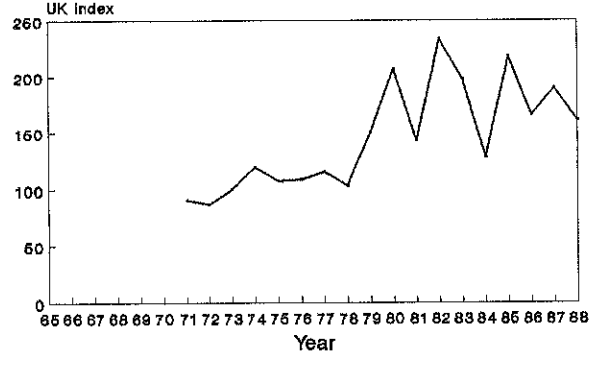


Figure 3.2.17 BAR-TAILED GODWIT

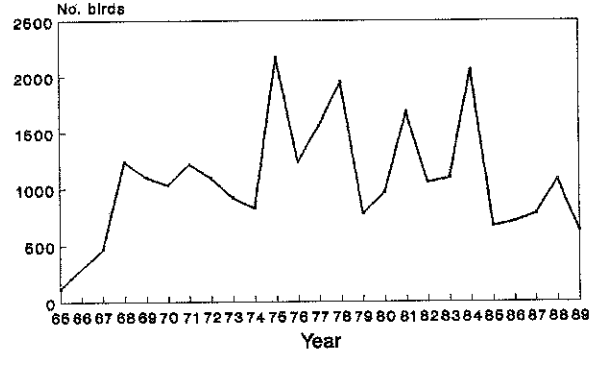
a. Seasonal abundance



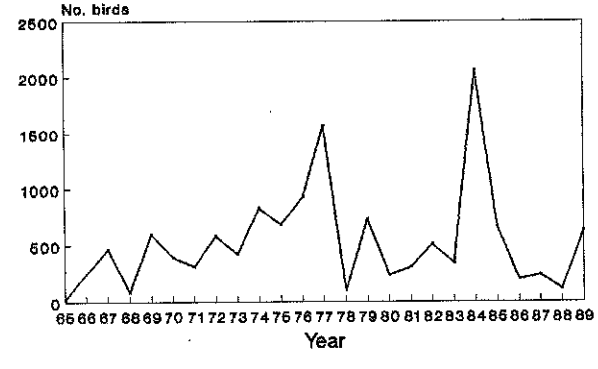
e. UK January index



c. Peak winter counts



d. January counts



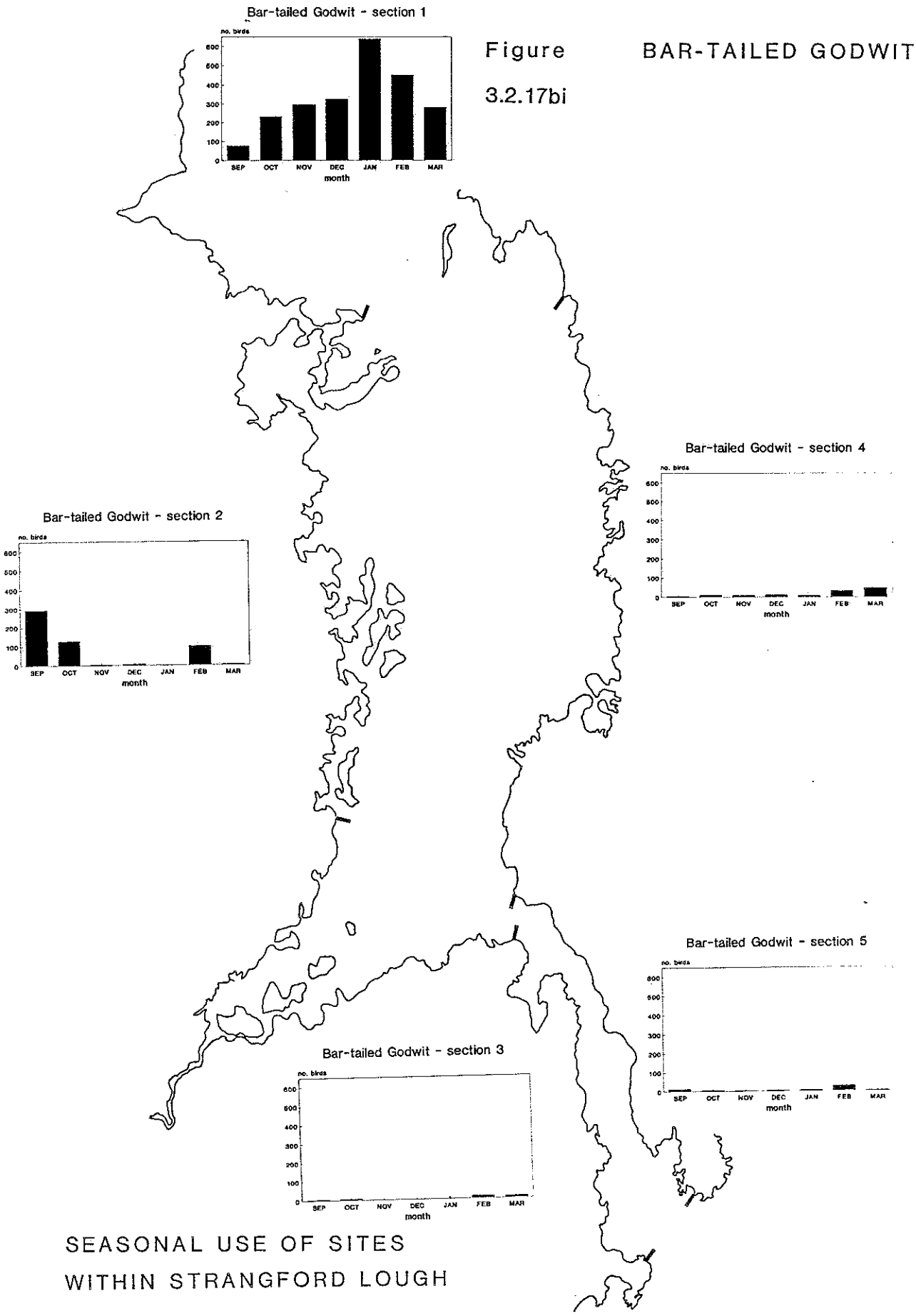


Figure 3.2.17bi BAR-TAILED GODWIT

SEASONAL USE OF SITES WITHIN STRANGFORD LOUGH

Figure 3.2.17bii BAR-TAILED GODWIT

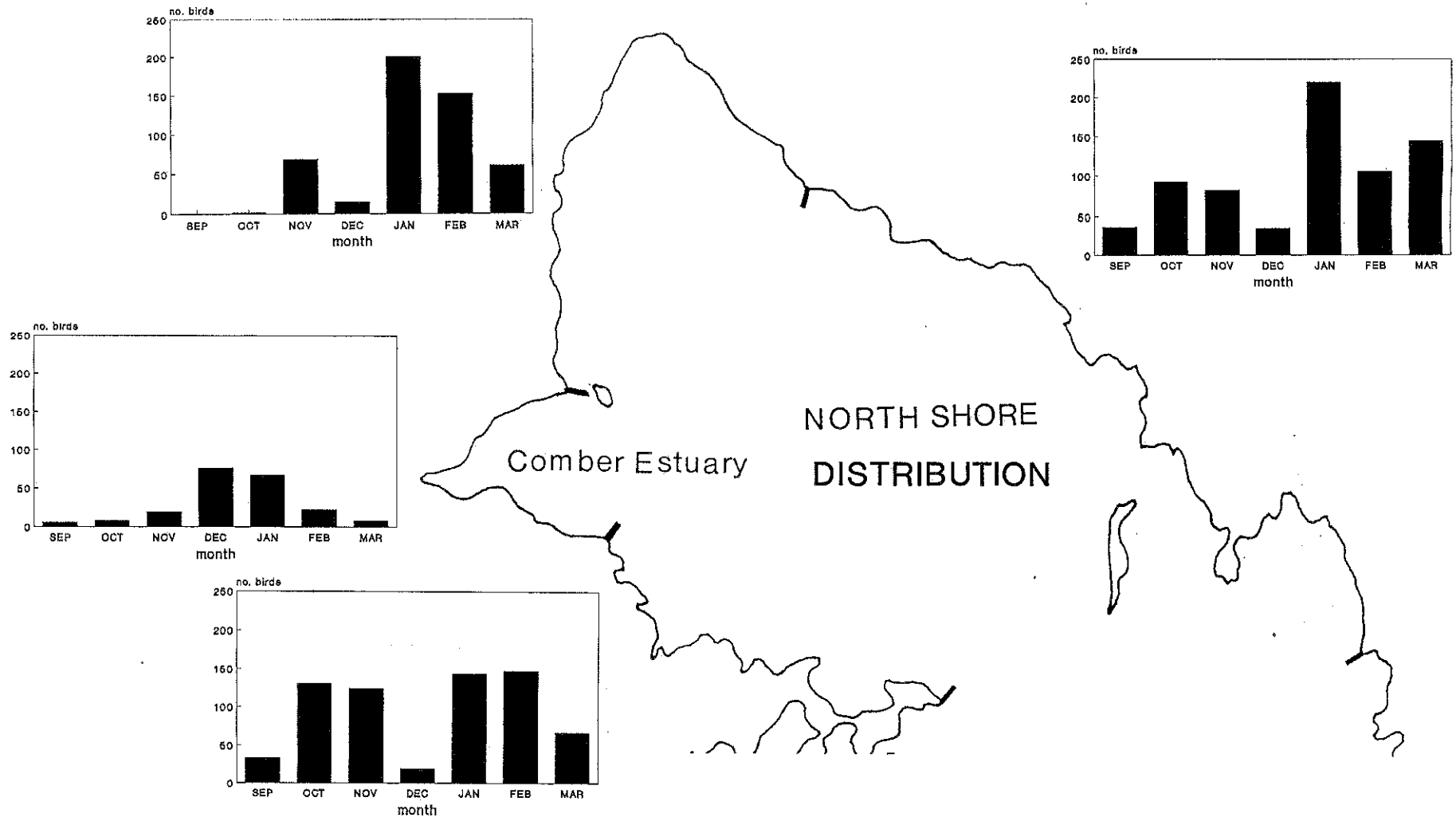


Figure 3.2.17biii BAR-TAILED GODWIT

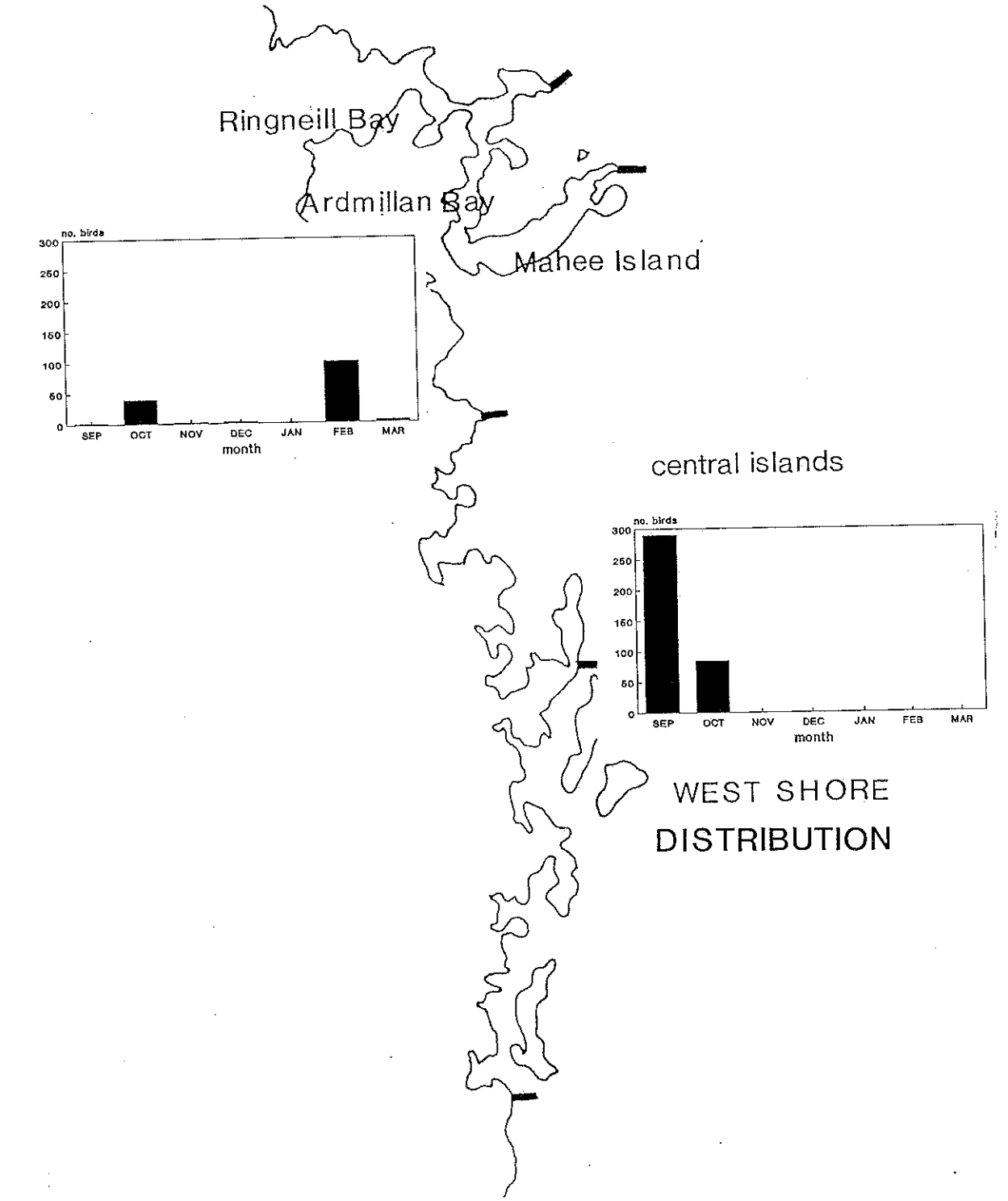
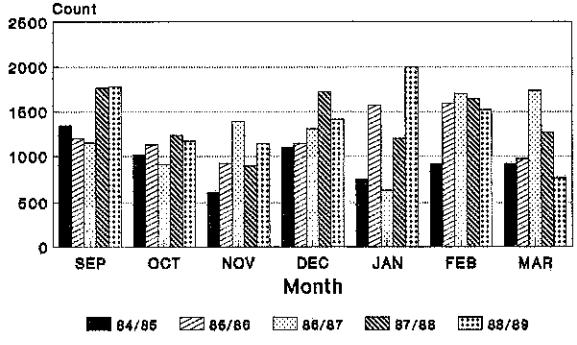
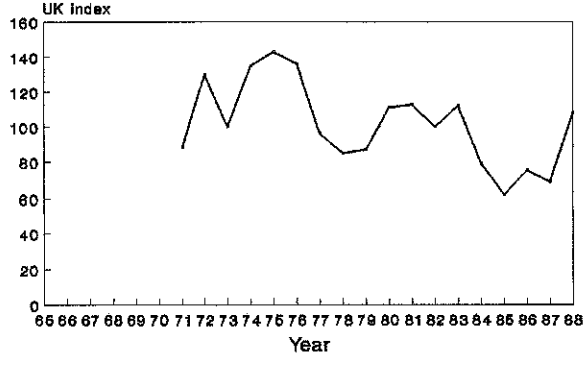


Figure 3.2.18 CURLEW

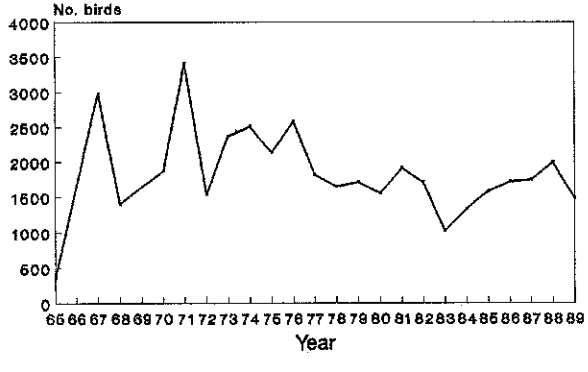
a. Seasonal abundance



e. UK January index



c. Peak winter counts



d. January counts

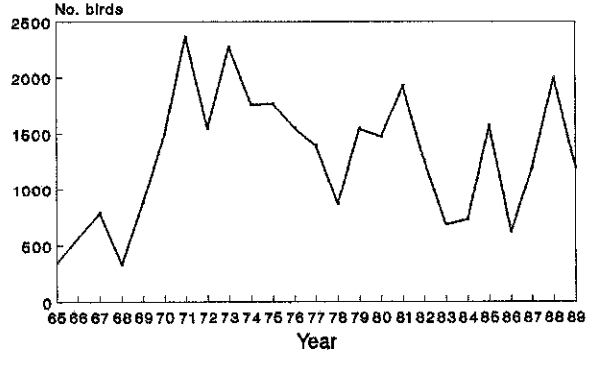
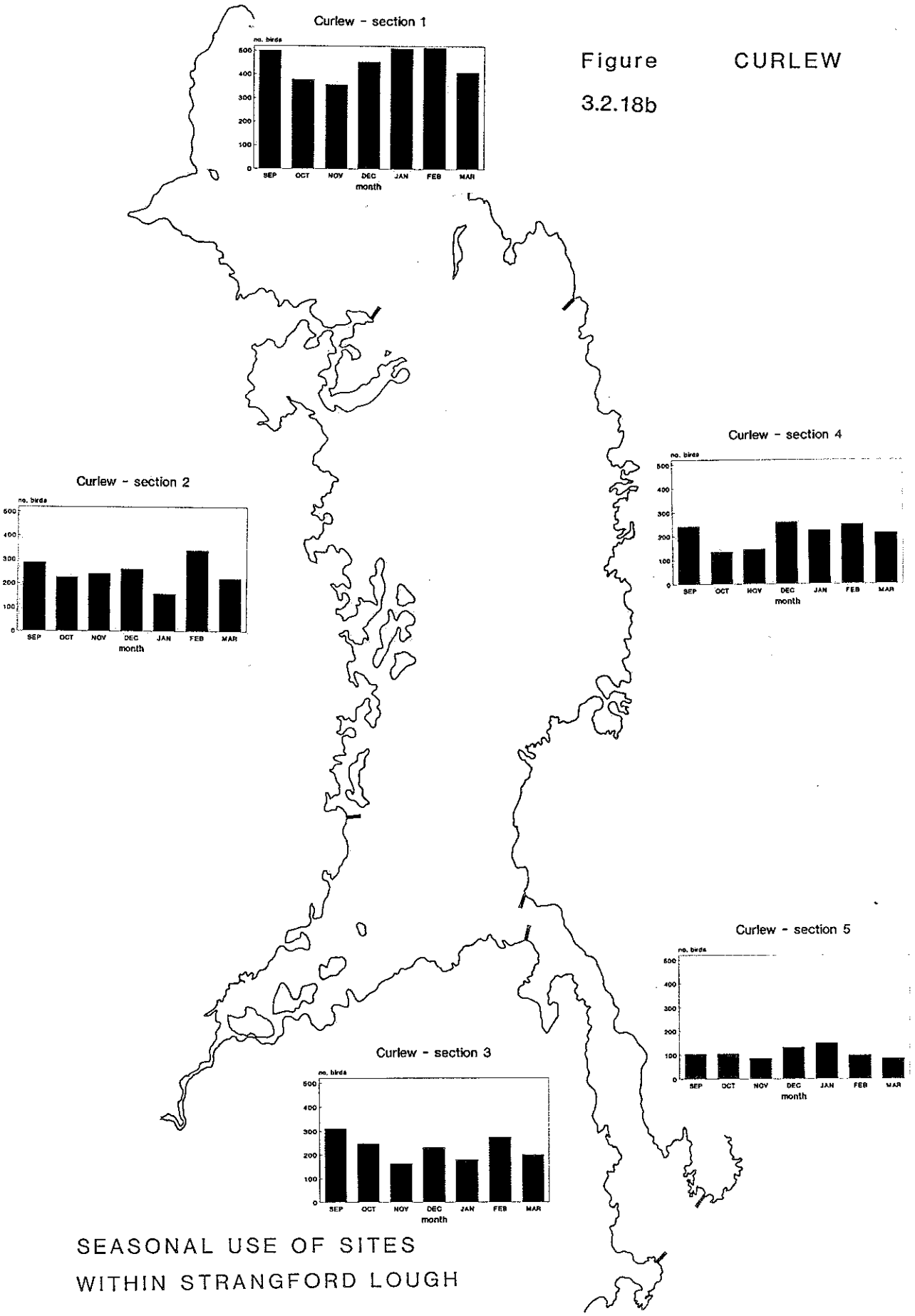


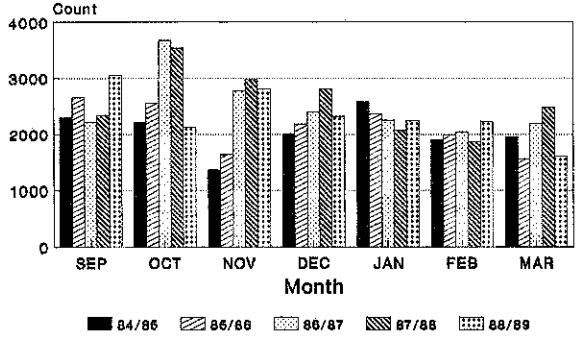
Figure 3.2.18b CURLEW



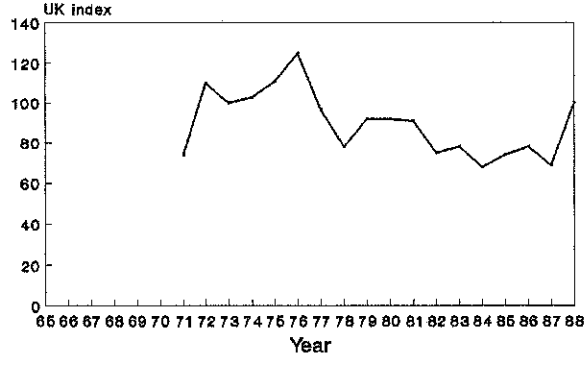
SEASONAL USE OF SITES
WITHIN STRANGFORD LOUGH

Figure 3.2.19 REDSHANK

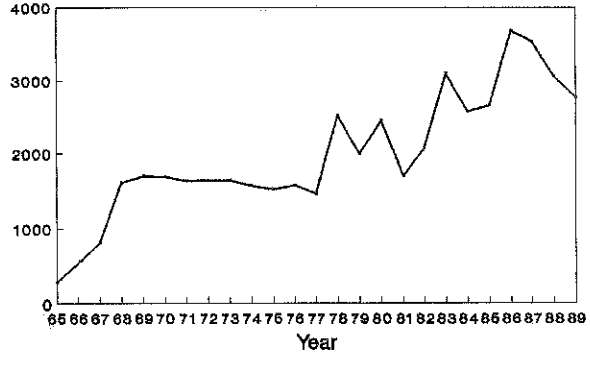
a. Seasonal abundance



e. UK January index



c. Peak winter counts



d. January counts

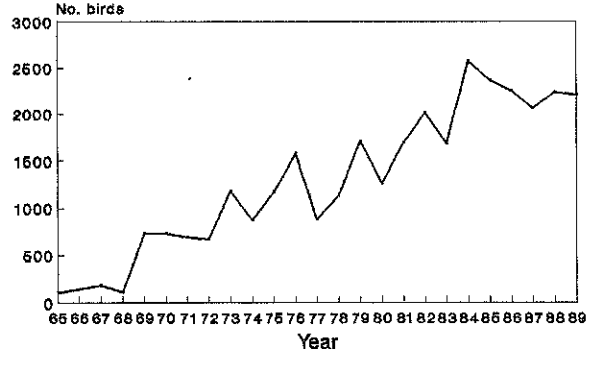
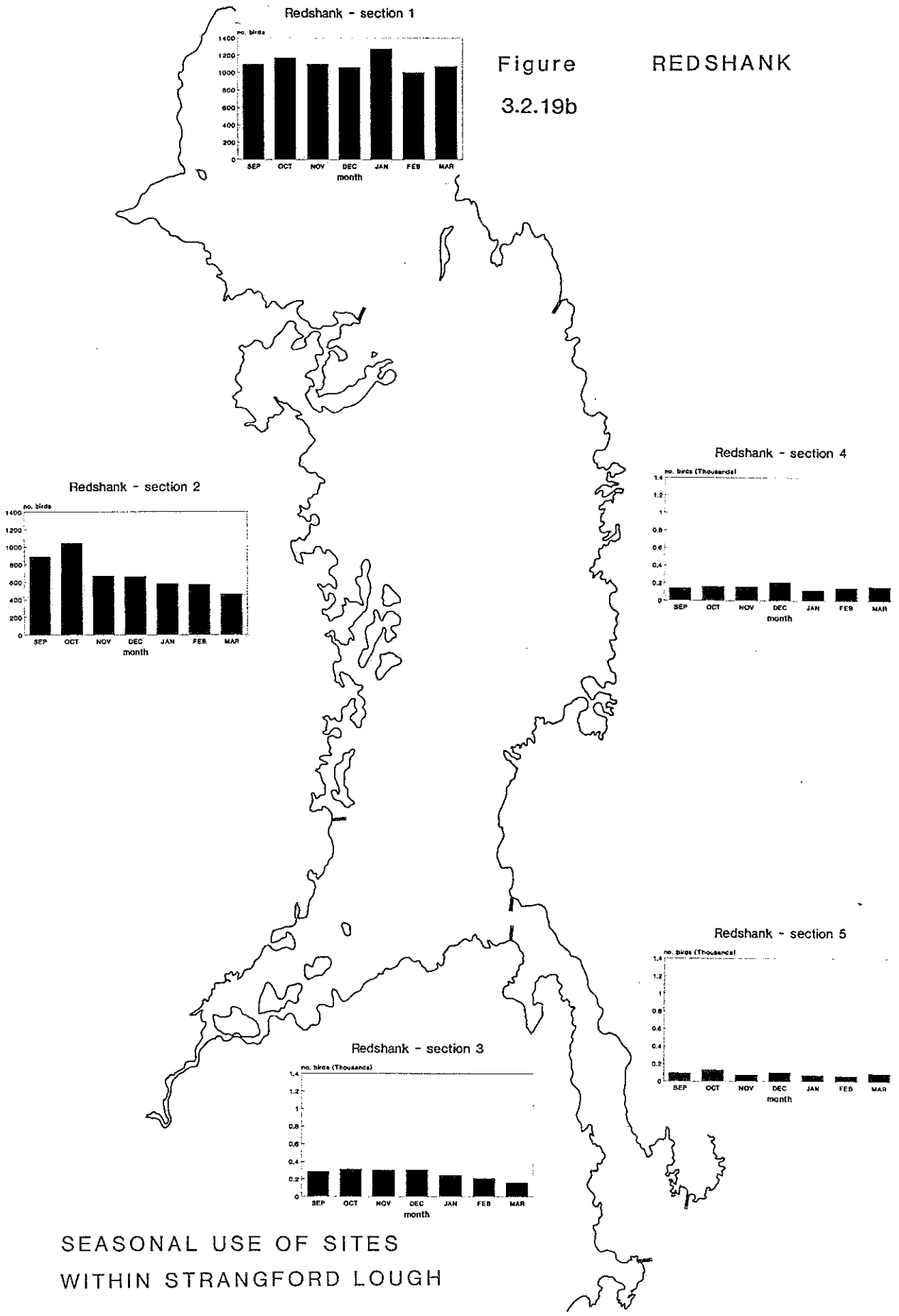


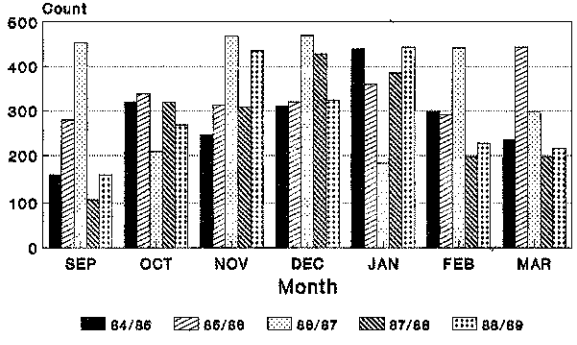
Figure 3.2.19b REDSHANK



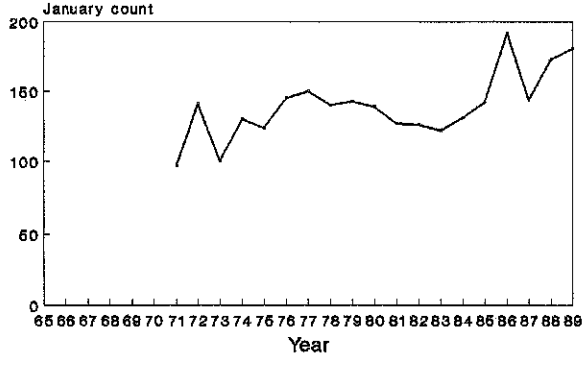
SEASONAL USE OF SITES
WITHIN STRANGFORD LOUGH

Figure 3.2.20 TURNSTONE

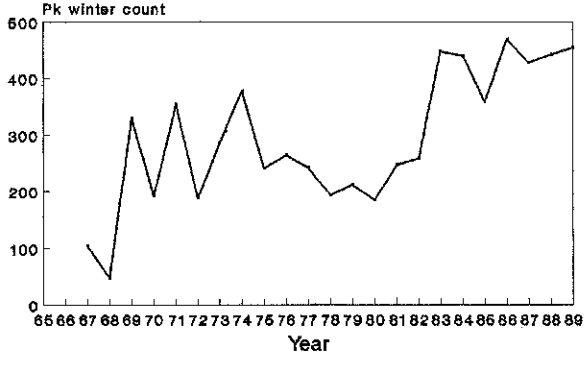
a. Seasonal abundance



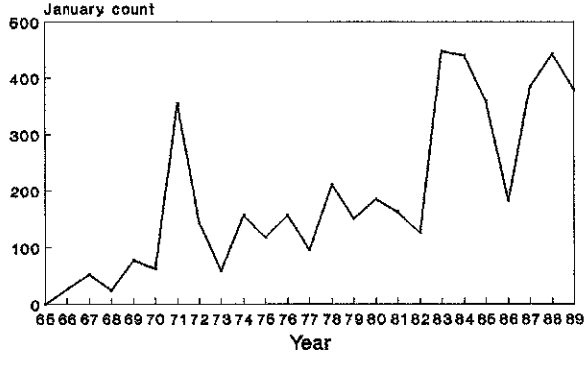
e. UK January index



c. Peak winter counts



d. January counts



REFERENCES

Boyd, H. & J-Y. Pirot (editors) (1989) Flyways and reserve networks for water birds. IWRB Special Publication No. 9

Campbell, L. H. (1978) Patterns of distributions and behaviour of flocks of seaducks wintering at Leith and Musselburgh, Scotland. Biol. Cons. 14:111-124.

Clark, N. A. (1989) Wader migration and distribution in South West Estuaries. Report by British Trust for Ornithology to the Department of Energy's Energy Technology Support Unit. Report No. ETSU TID 4055.

Davidson, N. C., K.-B. Strann, N. J. Crockford, J. R. Richardson, L. S. Standen, D. J. Townshend, J. D. Uttley, J. Wilson & A. G. Wood. (1986) The origins of Knots in arctic Norway in spring. Ornis Scand. 17:175-179.

Fox, A. D., M. Bell & J. Madsen (1990) The decline of Wigeon on Strangford Lough, with particular reference to Brent Goose/Wigeon interactions. Report by Wildfowl and Wetlands Trust to the International Waterfowl and Wetlands Research Bureau.

Fox, A. D. & C. Mitchell. (1988) Migration and seasonal distribution of Gadwall from Britain and Ireland: a preliminary assessment. Wildfowl 39:145-152.

Furness, R. W., H. Galbraith, I. P. Gibson & N. B. Metcalfe (1986) Recent changes in numbers of waders on the Clyde Estuary, and their significance for conservation. Proc. Roy. Soc. Edin. 90B:171-184.

Goss-Custard, J. D. (1977) The Ecology of the Wash.
III. Density-related behaviour and the possible effects of a loss of feeding grounds on wading birds (Charadrii). J. appl. Ecol. 14:721-739.

Goss-Custard, J. D. (1982) Use of mussel Mytilus edulis beds by Oystercatchers Haematopus ostralegus according to age and population size. Journal of Animal Ecology 51:543-554.

Green, P. (1990) The effects of organic inputs to estuaries on over-wintering bird populations and communities. Unpublished report by British Trust for Ornithology.

Hutchinson, Clive D. (1989) Birds in Ireland. Poyser, Calton. 215 pp.

Monval, J-Y. & J-Y. Pirot (compilers) (1989) Results of the IWRB International Waterfowl Census 1967 -1986. Population estimates, trends and distribution in selected species of ducks, swans and Coot (Fulica atra) wintering in the Western Palearctic and West Africa. IWRB Special Publication No. 8.

Moser, M. E. (1987) A Revision of Population Estimates for Waders (Charadrii) Wintering on the Coastline of Britain. Biol. Conserv. 39:153-164

Moser, M. E. (1988) Limits to the numbers of Grey Plovers Pluvialis squatarola wintering on British estuaries: an analysis of long-term population trends. J. appl. Ecol. 25:473-486.

Moser, M. E. & R. P. Prys-Jones (1988) Population estimates, distribution patterns and site evaluations for waders wintering on the coast of Northern Ireland. Irish Birds 3:551-568

O'Briain, M. (1985) Observations along the Irish east coast in winter 1983/84 of Brent Geese banded in the Canadian High Arctic. Irish East Coast Bird Rep. 1984:56-58.

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

Owen, M. & C. Mitchell (1988) Movements and migrations of Wigeon Anas penelope wintering in Britain and Ireland. Bird Study 35:47-59.

Pirot, J-Y, K. Laursen, J. Madsen & J-Y. Monval (1989) Populatio estimates of swans, geese, ducks and Eurasian Coot Fulica atra in the Western Palearctic and Sahelian Africa. pp 14-23 in H. Boyd & J-Y Pirot (editors).

Prater, A. J. (1981a) Estuary Birds of Britain and Ireland. Poyser, Calton. 440pp.

Pritchard, D. E. (1982) Feeding distribution of wintering shorebirds at Strangford Lough in relation to a barrage proposal. Report to RSPB

Pritchard, D. E. (1982) The feeding distribution of shorebirds at Strangford Lough and possible impact of a barrage. Irish Birds 2:176-188.

Salmon, D. G., R. P. Prys-Jones & J. S. Kirby (1989) Wildfowl and Wader Counts 1988-89: The Results of the National Wildfowl Counts and Birds of Estuaries Enquiry in the United Kingdom. The Wildfowl and Wetlands Trust, Slimbridge.

Salmon, D. G., R. P. Prys-Jones & J. S. Kirby (1988) Wildfowl and Wader Counts 1987-88: The Results of the National Wildfowl Counts and Birds of Estuaries Enquiry in the United Kingdom. The Wildfowl and Wetlands Trust, Slimbridge.

Salmon, D. G., R. P. Prys-Jones & J. S. Kirby (1987) Wildfowl and Wader Counts 1986-87: The Results of the National Wildfowl Counts and Birds of Estuaries Enquiry in the United Kingdom. The Wildfowl and Wetlands Trust, Slimbridge.

Salmon, D. G., M. E. Moser & J. S. Kirby (1987) Wildfowl and Wader Counts 1985-86: The Results of the National Wildfowl Counts and Birds of Estuaries Enquiry in the United Kingdom. The Wildfowl and Wetlands Trust, Slimbridge.

Salmon, D. G. & M. E. Moser (1985) Wildfowl an Wader Counts 1984-85: The Results of the National Wildfowl Counts and Birds of Estuaries Enquiry in the United Kingdom. The Wildfowl and Wetlands Trust, Slimbridge.

Smit, Cor J. & Theunis Piersma (1989) Numbers, midwinter distribution, and migration of wader populations using the East Atlantic flyway. pp 24-63 in H. Boyd & J-Y. Pirot (editors).

Summers, R. W. (1986) Breeding production of Dark-bellied Brent Geese Branta bernicla in relation to lemming cycles. Bird Study 33:105-108.

Summers, R. W. & L. G. Underhill (1987) Factors related to breeding production of Brent Geese Branta b bernicla and waders (Charadrii) on the Taimyr Peninsula. Bird Study 34:161-171.

Underhill, L. G. (1989) Indices for Waterbird Populations. BTO Research Report No. 52. A report on behalf of the British Trust for Ornithology to the International Waterfowl and Wetlands Research Bureau.

APPENDIX I POPULATION ESTIMATES FOR WILDFOWL AND WADERS IN NORTHERN IRELAND[1], ALL-IRELAND[2], THE UK[3] AND FLYWAY[4].

Species	N. Irl	All-Irl	UK	Flyway
Great-crested Grebe	1,780	-	12,000	-
Mute Swan	1,680	7,000	20,000	180,000
Bewick Swan	360	2,000	7,500	17,000
Whooper Swan	2,680	10,000	9,000	17,000
Greylag Goose	800	3,800	100,000	-
Brent Goose	15,100	20,000	20,000	20,000
Shelduck	3,280	12,500	80,000	250,000
Wigeon	17,800	-	270,000	750,000
Gadwall	180	450	5,000	12,000
Teal	5,100	50,000	100,000	400,000
Mallard	8,700	50,000	500,000	5,000,000
Pintail	300	2,000	25,000	70,000
Shoveler	280	4,200	9,000	40,000
Pochard	25,000	30,000	75,000	350,000
Tufted Duck	13,880	20,000	75,000	750,000
Scaup	1,920	2,600	5,000	150,000
Goldeneye	10,000	10,000	25,000	300,000
Red-breasted Merg	720	3,000	10,000	100,000
Coot	5,360	30,000	100,000	2,500,000
Oystercatcher	15,400	70,000	300,000	874,000
Ringed Plover	1,120	10,000	24,000	48,000
Golden Plover	9,600	100,000	200,000	-
Grey Plover	180	4,000	21,000	67,000
Lapwing	23,800	200,000	1,000,000	-
Knot	4,760	25,000	220,000	512,000
Dunlin	12,200	100,000	440,000	1,373,000
Blk-tailed Godwit	170	8,000	5,000	66,000
Bar-tailed Godwit	1,300	23,000	62,000	115,000
Curlew	6,580	100,000	98,000	348,000
Redshank	6,880	25,000	82,000	109,000
Greenshank	100	500	5,000	19,000
Turnstone	2,940	10,000	48,000	67,000

1 Salmon et al. 1987 a & b, 1988, 1989; Moser & Prys-Jones 1988
2 Sheppard (unpublished)
3 Moser 1987; Salmon et al. 1989, plus references quoted at 1
4 Pirot et al. 1989; Smit & Piersma 1989

APPENDIX II AVERAGE JANUARY COUNTS (1984/85 to 1988/89) OF WINTERING WILDFOWL AND WADERS AT STRANGFORD LOUGH

Species	Av. Jan count
Great-crested Grebe	43
Little Grebe	89
Mute Swan	106
Whooper Swan	18
Greylag Goose	305
Barnacle Goose	47
Brent Goose	3,459
Canada Goose	122
Shelduck	2,012
Wigeon	1,360
Gadwall	80
Teal	866
Mallard	1,111
Pintail	156
Shoveler	100
Pochard	291
Tufted Duck	222
Scaup	22
Goldeneye	223
Red-breasted Merganser	174
Coot	541
Oystercatcher	3,550
Ringed Plover	113
Golden Plover	2,600
Grey Plover	32
Lapwing	5,480
Knot	9,586
Dunlin	3,900
Common Snipe	54
Black-tailed Godwit	76
Bar-tailed Godwit	654
Curlew	1,224
Redshank	2,299
Greenshank	19
Turnstone	362