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Monitoring Bird Distribution and Behaviour on the Carmarthen Bay & Estuaries SAC at Low Tide

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EXECUTIVE SUMMARY

1. As part of CCW's monitoring and management programme of *Natura 2000* sites, a series of co-ordinated four-hour low water bird distribution surveys of the Carmarthen Bay & Estuaries Special Area of Conservation (including the Burry Inlet SPA, the Pembrey Coast and the Three Rivers complex) were organised.

2. The principal aims of the study were to ascertain bird movements and behaviour, particularly of the target species Knot and Oystercatcher, in the period immediately before and after low water. Counters were present on their sectors to begin surveys two hours before low tide, and continued surveys until two hours after low tide.

3. Within this period, each counter surveyed each of their count sectors at each of four hourly cycles: two hours before low tide, one hour before low tide**,** up to an hour after low tide and up to two hours after low tide. This enabled comparison of bird distributions at different tidal stages. One survey was performed during each of the winter months November – February.

4. Counters recorded bird species, numbers, apparent sources of distribution and the birds' reactions to disturbance. For Oystercatchers and Knot, behaviour was also recorded. This involved assessing the proportion of flocks feeding and resting / roosting within each sector, at each of the tidal stages. Flight directions of Oystercatchers were also recorded where possible, to indicate site usage and reveal movements between feeding and roosting sites (including outside the SAC).

5. Bird densities were reported, as was cockling and especially mussel-gathering activity, a predominant issue within the SAC. Target species were Oystercatcher and Knot, species likely to rely most heavily on shellfish, although all species present were surveyed where practical. Only species which are Burry Inlet SPA features are considered here.

6. Densities of feeding Oystercatcher and Knot generally decreased through the low tide period, and densities of roosting birds generally increased. However, Oystercatchers especially were still feeding in relatively high densities even two hours after low water, especially on the Pembrey Coast and Gwendraeth River.

7. Few Knot were recorded at roost, although sectors with high densities of feeding birds often rapidly changed between tidal stages. Feeding Oystercatcher densities changed most markedly on the Three Rivers complex and remained largely stable on the Pembrey Coast. Notable changes in roosting densities of Oystercatcher increased through the tidal cycle on the north Burry Inlet.

8. Incidences of cockling, mussel extraction, bait digging and recreational disturbance are presented.

9. There is some, though limited, evidence for movement of Oystercatcher between sectors on the Burry Inlet SPA and those on the Three Rivers complex.

10. Raw data will supplied to CCW in Excel format and ArcView GIS shapefiles.

CRYNODEB GWEITHREDOL

1. Fel rhan o raglen fonitro a rheoli safleoedd *Natura 2000* CCGC, trefnwyd cyfres o arolygon cydgysylltiedig pedair awr o hyd o ddosbarthiad adar adeg distyll ym Mae Caerfyrddin ac Aberoedd Ardal Cadwraeth Arbennig (gan gynnwys Porth Tywyn AGA, Arfordir Pembre a rhwydwaith y Tair Afon)

2. Prif nodau'r astudiaeth oedd canfod symudiadau ac ymddygiad adar, yn arbennig y rhywogaethau targed pibydd yr aber a'r bioden fôr, yn y cyfnod yn union cyn ac ar ôl distyll. Roedd cyfrifwyr yn bresennol yn eu sectorau i ddechrau'r arolygon ddwy awr cyn distyll, a pharhawyd â'r arolygon hyd ddwy awr ar ôl distyll.

3. O fewn y cyfnod yma, bu i bob cyfrifwr wneud arolwg o bob un o'i sectorau cyfrif ar bob cylch pedair awr: dwy awr cyn distyll, awr cyn distyll, hyd at awr ar ôl distyll. Roedd hyn yn ei gwneud yn bosib cymharu dosbarthiad adar ar wahanol gyfnodau o lanw. Cafodd un arolwg ei gwneud yn ystod pob un o fisoedd y gaeaf Tachwedd-Chwefror.

4. Bu i'r cyfrifwyr gofnodi rhywogaethau'r adar, y niferoedd, ffynonellau ymddangosiadol dosbarthiad ac ymateb yr adar i aflonyddiad. Cafodd ymddygiad hefyd ei gofnodi yn achos y bioden fôr a phibydd yr aber. Roedd hyn yn golygu asesu beth oedd cyfran yr heidiau oedd yn bwydo a gorffwyso / yn clwydo o fewn pob sector, ar bob un o'r cyfnodau llanw. Cafodd cyfeiriadau hediad pïod y môr hefyd eu cofnodi lle roedd hynny'n bosib er mwyn dangos defnydd o safle a symudiadau rhwng safloedd bwydo a chlwydo (gan gynnwys rhai y tu allan i'r ACA).

5. Adroddwyd ar ddwysedd adar, ac ar y gweitharedd o gasglu cocos ac yn arbennig y gweithgaredd o gasglu cregyn gleision, mater holl bwysig o fewn y ACA. Y rhywogaethau targed oedd y pïod môr a phibyddion yr aber, rhywogaethau sydd yn debygol o ddibynnu drymaf ar bysgod cregyn, er bod arolwg wedi'i gwneud, lle roedd hynny'n ymarferol, o'r holl rywogaethau oedd yn bresennol. Dim ond rhywogaethau sy'n nodweddion Porth Tywyn AGA sy'n cael eu hystyried yma.

6. Roedd dwysedd bwydo y bioden fôr a phibydd yr aber yn lleihau yn gyffredinol trwy'r cyfnod distyll ac roedd dwysedd adar oedd yn clwydo yn cynyddu'n gyffredinol. Fodd bynnag, roedd pïod môr yn arbennig yn dal i fwydo mewn dwsyeddau cymharol uchel bob dwy awr ar ôl distyll, yn enwedig ar Arfordir Pembre ac ar Afon Gwendraeth.

7. Ychydig o bïod môr a gofnodwyd yn clwydo, er bod sectorau gyda dwyseddau uchel o adar yn bwydo yn aml yn newid yn gyflym rhwng y gwahanol gyfnodau llanw. Roedd y newid mwyaf arwyddocaol mewn dwyseddau pïod môr yn bwydo ar rwydwaith y Tair Afon. Bu iddo aros yn gymharol gyson ar Arfordir Pembre. Roedd newidiadau arwyddocaol yn nwysterau clwydo pïod y môr yn cynyddu trwy'r cylch llanw ar ochr ogleddol Porth Tywyn.

8. Cyflwynir achosion o gasglu cocos, o dynnu cregyn gleision, o dyllu am abwydau a hefyd o aflonyddu adloniadol.

9. Ceir rhywfaint, er mai cyfyngedig ydyw, o dystiolaeth o symudiad pïod y môr rhwng sectorau ar Borth Tywyn ACA ac ar rai ar rwydwaith y Tair Afon.

10. Cyflwynir data crai i GCGC ar fformat Excel ac ar shapeffeiliau Arc View GIS.

1. INTRODUCTION

The Burry Inlet Special Protection Area (SPA) supports nationally and internationally important populations of wintering wildfowl and waders (specifically Shelduck *Tadorna tadorna*, Pintail *Anas acuta*, Shoveler *Anas clypeata*, Oystercatcher *Haematopus ostralegus*, Knot *Calidris canutus*, Dunlin *Calidris alpina*, Black-tailed Godwit *Limosa limosa* and Curlew *Numenius arquata*). The Countryside Council for Wales (CCW) has commissioned a study to determine the food requirements of Oystercatcher and Knot, to set monitoring targets and to help assess the implications of cockle and mussel fishing scenarios on the bird populations (West *et al.* in press).

To consider in full the impact such scenarios may have on wintering waterbirds, an area encompassing most of the Carmarthen Bay & Estuaries Special Area of Conservation (SAC), from Pendine east to Pontardulais, was surveyed at low tide. This approach was intended to indicate whether birds are using areas outside the Burry Inlet SPA (*e.g.* Pembrey Coast) and also to reveal temporal and spatial aspects of movements between feeding and roosting sites. No additional waterbird species are designated for the area of the SAC outside the Burry Inlet SPA.

2. METHODS

2.1 Survey Methods

Monthly counts were made from November 2006 to February 2007 (four counts in total), broadly using Wetland Bird Survey (WeBS) Low Tide Count methodology (Banks *et al.* 2006). These counts were focused on the priority species of Knot and Oystercatcher but included all species where counting these was practical. Counts aimed to fall midway between spring and neap tide, although in practice only limited days each month were favourable for the low tide period to occur in daylight hours. Counts took place for two hours either side of low tide. Data recorded included metadata such as date, time, location (count sector) and surveyors names, as well as bird species, numbers, sources of distribution and the birds reactions to disturbance.

Where possible, counts of different sectors were made synchronously. However, in practice some sectors were covered on different days; this is permissible under WeBS Low Tide Count methodology, but should be considered when interpreting data (*i.e.* it is probable that an element of double-counting exists).

For Oystercatcher and Knot, behaviour was also recorded. This included ascertaining the proportion of flocks feeding and resting, as well as recording the location and behaviour (feeding / roosting) of birds on falling and rising tides. The flight directions for Oystercatchers were also recorded where possible.

2.2 Site Coverage

Sectors comprising intertidal and non-tidal habitat encompassing the entirety of the Carmarthen Bay & Estuaries SAC, including Burry Inlet SPA, the Pembrey coast and the Three Rivers complex, were based on pre-existing WeBS Low Tide Count sectors. Some sectors were combined or split depending on counter accessibility and visibility (*e.g.* some very large sectors of the Burry Inlet were covered from both north and south shores). A total of 42 sectors was visited.

Sectors covered are shown in Figures 2.2.1 – 2.2.4.

Figure 2.2.1 Burry Inlet SPA count sectors. Unlabelled sectors shown in next figure.

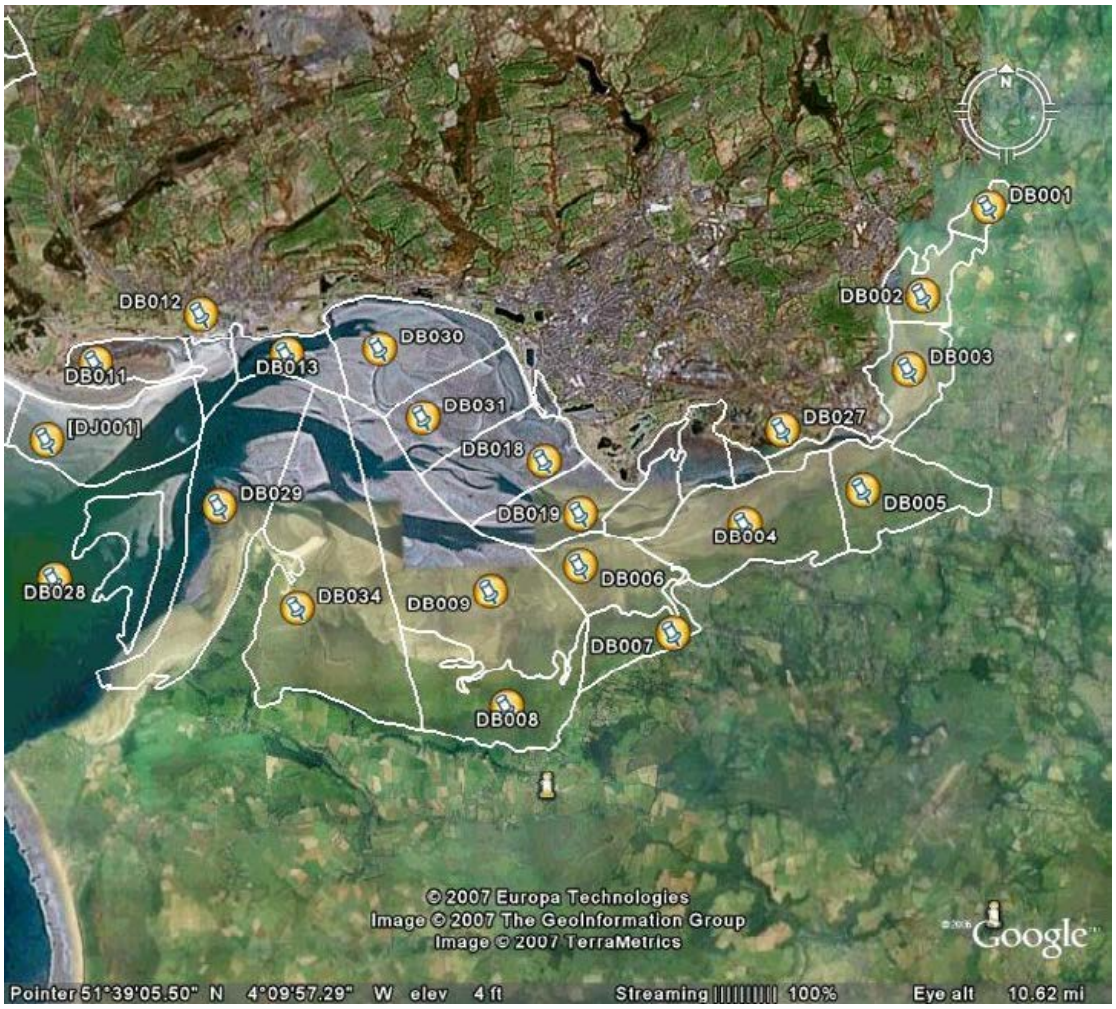


Figure 2.2.2 Close-up of Llanelli area Burry Inlet SPA count sectors.

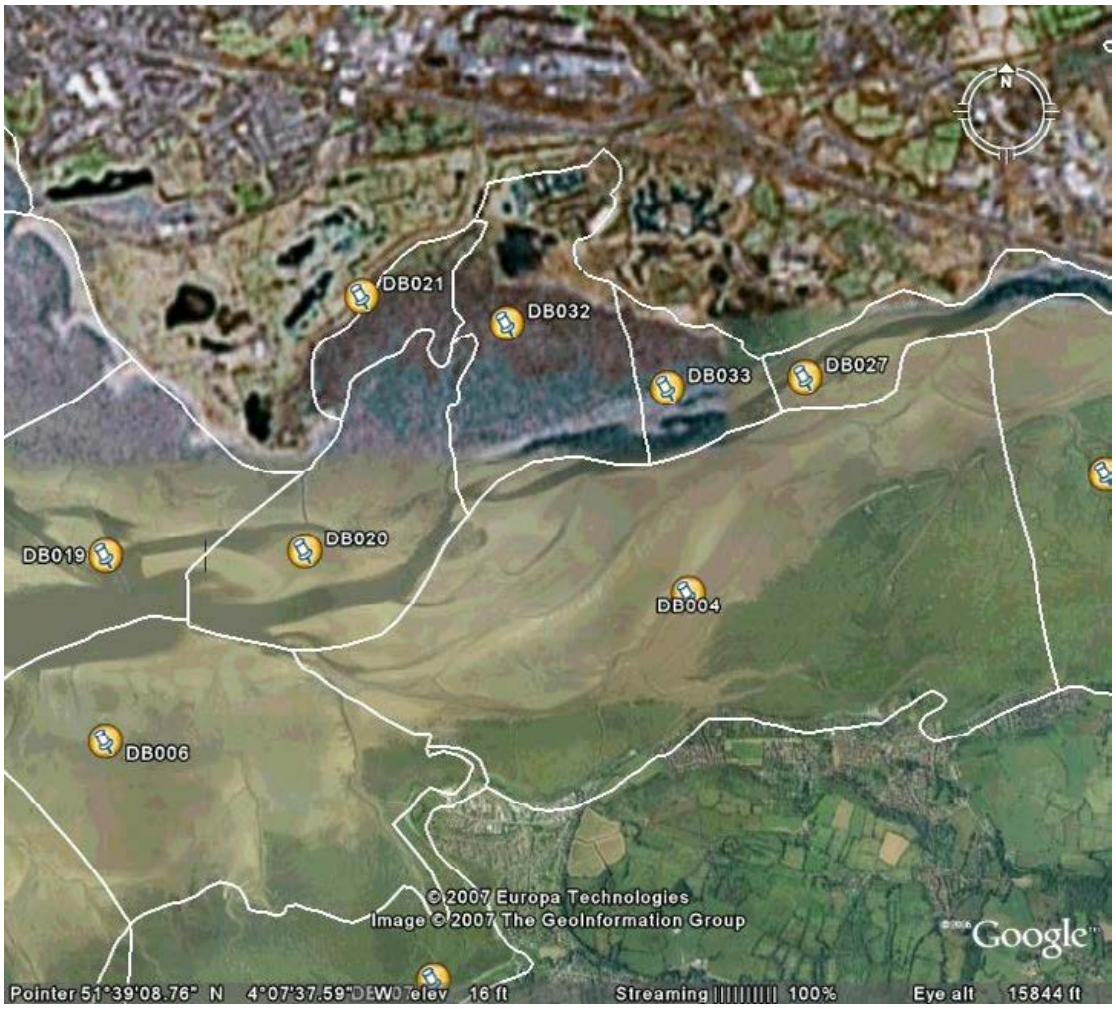


Figure 2.2.3 Pembrey Coast and Gwendraeth River count sectors.

Figure 2.2.4 Pendine Sands, Taf and Tywi Rivers count sectors.

2.3 Data Analysis

In order to ensure maximum integrity of the dataset, it was necessary to carefully examine count data submitted for each sector. Where sectors had been visited on multiple occasions, only one surveyor's results were used. Selection was based on temporal proximity of the count to most other sector counts and consistency of counter identity through the winter. Multiple counts of sectors with the same code were allowed where counters were confident that there had been little or no overlap between their respective areas of view, and such counts were combined for the sector.

Summary data were produced using the SAS system, and maps were produced in ArcView GIS and Google Earth.

3. RESULTS

3.1 Sector Coverage

The overall intertidal, sub-tidal and non-tidal areas counted for each sector during each of the four tidal stages in which counts were made are shown in Table 3.1.

Table 3.1 Overall counted area (in hectares) of each of the sectors in each month by tidal state, where –2 = count period beginning two hours before low tide and +2 = count period ending two hours after low tide.

Sector code	Inter-tidal (ha)	Sub-tidal (ha)	Non-tidal (ha)	Total (ha)	Months counted	Nov	Dec	Jan	Feb
DB001	21	12	26	59	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB002	69	17	71	157	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB003	102	27	76	205	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB004	316	31	157	504	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB005	82	6	238	326	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB006	238	19	0	257	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB008	0	0	433	433	Dec		-2, -1, +1, +2		
DB009	823	77	0	900	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB011	25	0	131	156	Jan			-1,+1	
DB012	52	31	0	83	Dec,Jan,Feb		-2, -1, +1, +2	-2, -1, +1, +2	-2, +1
DB013	47	108	0	155	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB018	286	42	0	328	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB019	168	69	0	237	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB020	117	11	0	128	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1	-2, -1, +1, +2
DB021	0	0	33	33	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1	-2, -1, +1	-2, -1, +1, +2
DB027	25	11	18	54	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB028	207	0	0	207	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB029	344	401	0	745	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB030	313	117	0	430	Nov,Dec,Jan,Feb	-2, +1	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +2
DB031	251	71	0	322	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB032	42	8	69	119	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB033	21	5	15	41	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DB034	635	29	403	1067	Dec		-2, -1, +1, +2		
DJ001	219	202	0	421	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-1, +1	-2, +1, +2
DJ002	359	234	0	593	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-1, +1	-2, +1, +2
DJ003	231	114	0	345	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1	-2, -1, +1, +2	-2, -1, +1, +2
DJ004	516	144	215	875	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2

Sector code	Inter-tidal (ha)	Sub-tidal (ha)	Non-tidal (ha)	Total (ha)	Months counted	Nov	Dec	Jan	Feb
DJ005	26	0	258	284	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DJ006	109	4	61	174	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DJ007	22	3	11	36	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1	-2, -1, +1, +2	-2, -1, +1, +2
DJ008	2	0	3	5	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DJ009	5	1	18	24	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DJ010	15	5	1	21	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1	-2, -1, +1, +2	-2, -1, +1, +2
DJ011	5	2	3	10	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1	-2, -1, +1, +2	-2, -1, +1, +2
DJ012	16	3	3	22	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1	-2, -1, +1, +2	-2, -1, +1, +2
DJ013	56	6	2	64	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1	-2, -1, +1, +2	-2, -1, +1, +2
DJ015	85	43	5	133	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1	-2, -1, +1, +2	-2, -1, +1, +2
DJ021	150	33	8	191	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1	-2, -1, +1, +2	-2, -1, +1, +2
DJ022	340	61	3	404	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1	-2, -1, +1, +2	-2, -1, +1, +2
DJ023	115	11	4	130	Nov,Dec,Jan,Feb	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2	-2, -1, +1, +2
DJ024	328	28	11	367	Nov,Jan,Feb	-2, -1, +1, +2		-2, -1, +1, +2	-2, -1, +1, +2
DJ025	826	650	0	1476	Dec,Jan,Feb		-2, -1, +1	-2, -1, +1, +2	-2, -1, +1, +2
Total	7,584	2,636	2,145	12,365					

[1] Some counts in December were curtailed by increasingly poor weather conditions.
[2] Sector DB012 could not be visited four times through the count period in November and January.
[3] Blank cells indicate sector / month combinations where no count was possible, because of weather conditions or unforeseen counter availability.

3.2 Bird Counts Through the Low Tide Period

Note that in the following results, for some designated feature species other than Knot and Oystercatcher, for some sector / month combinations, distinction was not made between feeding and roosting birds. In such cases, all counts have thus been allocated to the feeding category. However, the distinction was always made for counts of Knot and Oystercatcher.

3.2.1 Two hours before low tide

The number of roosting and feeding birds of each species that is a designated feature of the Burry Inlet SPA, recorded two hours before low tide in each month is shown in Table 3.2.1.1. The mean count and density of feeding birds recorded two hours before low tide, together with their preferred habitat is shown in Table 3.2.1.2. Mean and peak densities of Oystercatcher and Knot on individual sectors are shown in Appendix 1 (section 5).

Table 3.2.1.1 Monthly counts of roosting (roost.) and feeding (feed.) birds (designated features only) made two hours before low tide for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC.

Species	Nov roost.	Nov feed.	Dec roost.	Dec feed.	Jan roost.	Jan feed.	Feb roost.	Feb feed.	Maximum roosting	Maximum feeding
Oystercatcher	4,398	13,594	10,357	15,326	6,290	12,885	3,385	13,894	10,357	15,326
Knot	372	1,364	640	3,611	34	3,970	1,267	5,475	1,267	5,475
Dunlin	65	5,319	0	6,390	700	5,213	1,013	6,711	1,013	6,711
Black-tailed Godwit	61	157	0	120	164	75	90	125	164	157
Curlew	204	1,003	7	847	36	969	537	996	537	1,003
Shelduck	205	353	81	253	23	418	214	424	214	424
Pintail	201	0	179	3	139	1	363	17	363	17
Shoveler	7	30	13	34	3	17	4	0	13	34

Table 3.2.1.2 Mean counts and density of roosting and feeding birds (birds per hectare, designated features only) made two hours before low tide for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC.

Species	Preferred habitat	Total preferred habitat (ha)	Mean roosting	Mean feeding	Mean roosting density	Mean feeding density
Oystercatcher	Intertidal	7,587	6,556	14,917	0.86	1.97
Knot	Intertidal	7,587	578	3,785	0.08	0.50
Dunlin	Intertidal	7,587	445	6,117	0.06	0.81
Black-tailed Godwit	Intertidal & non-tidal	9,732	79	119	0.01	0.01
Curlew	Intertidal & non-tidal	9,732	196	954	0.02	0.10
Shelduck	All habitats	12,368	157	416	0.01	0.03

Species	Preferred habitat	Total preferred habitat (ha)	Mean roosting	Mean feeding	Mean roosting density	Mean feeding density
Pintail	All habitats	12,368	227	6	0.02	0.00
Shoveler	All habitats	12,368	7	20	0.00	0.00

3.2.2 One hour before low tide

The number of roosting and feeding birds of each species that is a designated feature of the Burry Inlet SPA, recorded one hour before low tide in each month is shown in Table 3.2.2.1. The mean count and density of feeding birds recorded one hour before low tide that are designated features of the Burry Inlet SPA, together with their preferred habitat is shown in Table 3.2.2.2. Mean and peak densities of Oystercatcher and Knot on individual sectors are shown in Appendix 1 (section 5).

Table 3.2.2.1 Monthly counts of roosting (roost.) and feeding (feed.) birds (designated features only) made one hour before low tide for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC.

Species	Nov roost.	Nov feed.	Dec roost.	Dec feed.	Jan roost.	Jan feed.	Feb roost.	Feb feed.	Maximum roosting	Maximum feeding
Oystercatcher	11,302	8,474	14,562	12,945	5,857	13,675	3,309	9,411	14,562	13,675
Knot	1,300	408	440	2,449	575	2,697	552	1,058	1,300	2,697
Dunlin	500	3,809	1,450	4,946	507	9,610	3,220	3,392	3,220	9,610
Black-tailed Godwit	0	175	0	73	300	58	0	7	300	175
Curlew	193	907	39	872	12	857	486	833	486	907
Shelduck	321	281	54	274	19	399	186	523	321	523
Pintail	163	0	71	77	372	26	486	7	486	77
Shoveler	30	7	23	28	5	1	2	2	30	28

Table 3.2.2.2 Mean counts and density of roosting and feeding birds (birds per hectare, designated features only) made one hour before low tide for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC.

Species	Preferred habitat	Total preferred habitat (ha)	Mean roosting	Mean feeding	Mean roosting density	Mean feeding density
Oystercatcher	Intertidal	7,587	9,306	12,067	1.23	1.59
Knot	Intertidal	7,587	717	1,659	0.09	0.22
Dunlin	Intertidal	7,587	1,458	5,838	0.19	0.77
Black-tailed Godwit	Intertidal & non-tidal	9,732	75	78	0.01	0.01

Species	Preferred habitat	Total preferred habitat (ha)	Mean roosting	Mean feeding	Mean roosting density	Mean feeding density
Curlew	Intertidal & non-tidal	9,732	183	886	0.02	0.09
Shelduck	All habitats	12,368	158	444	0.01	0.04
Pintail	All habitats	12,368	279	30	0.02	0.00
Shoveler	All habitats	12,368	15	10	0.00	0.00

3.2.3 One hour after low tide

The number of roosting and feeding birds of each species that is a designated feature of the Burry Inlet SPA, recorded one hour after low tide in each month is shown in Table 3.2.3.1. The mean count and density of feeding birds recorded one hour after low tide that are designated features of the Burry Inlet SPA, together with their preferred habitat is shown in Table 3.2.3.2. Mean and peak densities of Oystercatcher and Knot on individual sectors are shown in Appendix 1 (section 5).

Table 3.2.3.1 Monthly counts of roosting (roost.) and feeding (feed.) birds (designated features only) made one hour after low tide for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC.

Species	Nov roost.	Nov feed.	Dec roost.	Dec feed.	Jan roost.	Jan feed.	Feb roost.	Feb feed.	Maximum roosting	Maximum feeding
Oystercatcher	12,752	10,489	13,051	9,847	6,610	11,112	3,699	12,307	13,051	12,307
Knot	1,580	111	1,930	352	552	1,539	422	2,435	1,930	2,435
Dunlin	1,625	5,163	4,811	2,574	910	7,171	3,743	4,054	4,811	7,171
Black-tailed Godwit	70	109	0	69	300	40	0	0	300	109
Curlew	550	742	10	703	3	600	364	756	550	756
Shelduck	216	413	5	352	26	384	173	390	216	413
Pintail	128	105	60	4	255	24	576	29	576	105
Shoveler	35	0	55	8	4	12	0	0	55	12

Table 3.2.3.2 Mean counts and density of roosting and feeding birds (birds per hectare, designated features only) made one hour after low tide for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC.

Species	Preferred habitat	Total preferred habitat (ha)	Mean roosting	Mean feeding	Mean roosting density	Mean feeding density
Oystercatcher	Intertidal	7,587	9,768	11,130	1.29	1.47
Knot	Intertidal	7,587	1,121	1,110	0.15	0.15
Dunlin	Intertidal	7,587	2,828	4,750	0.37	0.63

Species	Preferred habitat	Total preferred habitat (ha)	Mean roosting	Mean feeding	Mean roosting density	Mean feeding density
Black-tailed Godwit	Intertidal & non-tidal	9,732	93	55	0.01	0.01
Curlew	Intertidal & non-tidal	9,732	240	726	0.02	0.07
Shelduck	All habitats	12,368	110	464	0.01	0.04
Pintail	All habitats	12,368	264	42	0.02	0.00
Shoveler	All habitats	12,368	24	5	0.00	0.00

3.2.4 Two hours after low tide

The number of roosting and feeding birds of each species that is a designated feature of the Burry Inlet SPA, recorded two hours after low tide in each month is shown in Table 3.2.4.1. The mean count and density of feeding birds recorded two hours after low tide that are designated features of the Burry Inlet SPA, together with their preferred habitat is shown in Table 3.2.4.2. Mean and peak densities of Oystercatcher and Knot on individual sectors are shown in Appendix 1 (section 5).

Table 3.2.4.1 Monthly counts of roosting (roost.) and feeding (feed.) birds (designated features only) made two hours after low tide for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC.

Species	Nov roost.	Nov feed.	Dec roost.	Dec feed.	Jan roost.	Jan feed.	Feb roost.	Feb feed.	Maximum roosting	Maximum feeding
Oystercatcher	13,297	8,254	10,794	8,408	6,787	7,505	4,582	11,466	13,297	11,466
Knot	730	242	87	632	1,809	1,111	0	2,520	1,809	2,520
Dunlin	3,340	4,618	200	6,884	30	6,269	667	7,881	3,340	7,881
Black-tailed Godwit	10	14	72	18	0	40	193	6	193	40
Curlew	595	712	164	647	1	665	381	818	595	818
Shelduck	194	411	13	288	12	557	114	472	194	557
Pintail	123	25	53	16	269	25	689	29	689	29
Shoveler	14	0	5	57	9	8	0	0	14	57

Table 3.2.4.2 Mean counts and density of roosting and feeding birds (birds per hectare, designated features only) made two hours after low tide for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC.

Species	Preferred habitat	Total preferred habitat (ha)	Mean roosting	Mean feeding	Mean roosting density	Mean feeding density
Oystercatcher	Intertidal	7,587	10,211	10,327	1.35	1.36
Knot	Intertidal	7,587	776	1,274	0.10	0.17
Dunlin	Intertidal	7,587	1,065	6,931	0.14	0.91
Black-tailed Godwit	Intertidal & non-tidal	9,732	85	24	0.01	0.00
Curlew	Intertidal & non-tidal	9,732	317	779	0.03	0.08
Shelduck	All habitats	12,368	85	512	0.01	0.04
Pintail	All habitats	12,368	340	27	0.03	0.00
Shoveler	All habitats	12,368	7	16	0.00	0.00

3.3 Mean Bird Counts Throughout the Low Tide Period

The number of roosting and feeding birds of each species that is a designated feature of the Burry Inlet SPA in each month (mean across tidal cycle) is shown in Table 3.3.1. The mean count and density of feeding birds that are designated features of the Burry Inlet SPA (mean across tidal cycle), together with their preferred habitat is shown in Table 3.3.2. Mean and peak densities of Oystercatcher and Knot on individual sectors are shown in Appendix 1 (section 5).

Table 3.3.1 Monthly counts of roosting (roost.) and feeding (feed.) birds (designated features only) for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC (mean across tidal cycle).

Species	Nov roost.	Nov feed.	Dec roost.	Dec feed.	Jan roost.	Jan feed.	Feb roost.	Feb feed.	Maximum roosting	Maximum feeding
Oystercatcher	10,531	10,205	12,339	13,170	6,537	13,088	3,814	12,893	12,339	13,170
Knot	996	531	882	2,030	743	2,329	560	3,049	996	3,049
Dunlin	1,383	4,727	1,616	5,316	812	8,310	2,236	6,017	2,236	8,310
Black-tailed Godwit	35	114	24	88	255	53	71	35	255	114
Curlew	386	841	56	819	13	785	442	851	442	851
Shelduck	234	365	39	292	20	449	172	452	234	452
Pintail	154	33	95	25	259	19	529	21	529	33
Shoveler	22	9	24	32	5	10	2	1	24	32

Table 3.3.2 Mean counts and density of roosting and feeding birds (birds per hectare, designated features only) for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC (mean across tidal cycle).

Species	Preferred habitat	Total preferred habitat (ha)	Mean roosting	Mean feeding	Mean roosting density	Mean feeding density
Oystercatcher	Intertidal	7,612	8,310	12,552	1.09	1.65
Knot	Intertidal	7,612	795	1,985	0.10	0.26
Dunlin	Intertidal	7,612	1,512	6,066	0.20	0.80
Black-tailed Godwit	Intertidal & non-tidal	9,888	96	73	0.01	0.01
Curlew	Intertidal & non-tidal	9,888	226	840	0.02	0.08
Shelduck	All habitats	12,524	126	448	0.01	0.04
Pintail	All habitats	12,524	264	26	0.02	0.00
Shoveler	All habitats	12,524	13	13	0.00	0.00

3.4 Peak Bird Counts Throughout the Low Tide Period

The number of roosting and feeding birds of each species that is a designated feature of the Burry Inlet SPA in each month (maximum across tidal cycle) is shown in Table 3.4.1. The mean count and density of feeding birds that are designated features of the Burry Inlet SPA (maximum across tidal cycle), together with their preferred habitat is shown in Table 3.4.2. Mean and peak densities of Oystercatcher and Knot on individual sectors are shown in Appendix 1 (section 5).

Table 3.4.1 Monthly counts of roosting and feeding birds (designated features only) for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC (maximum across tidal cycle).

Species	Nov roost.	Nov Feed.	Dec roost.	Dec feed.	Jan roost.	Jan feed.	Feb roost.	Feb feed.	Maximum roosting	Maximum feeding
Oystercatcher	18,146	18,407	22,875	21,460	11,498	18,399	6,128	17,182	22,875	21,460
Knot	1,752	1,446	2,347	4,340	2,273	4,005	1,824	6,905	2,347	6,905
Dunlin	3,506	9,690	5,061	9,790	1,767	11,683	5,398	11,097	5,398	11,683
Black-tailed Godwit	80	220	72	138	300	80	193	125	300	220
Curlew	776	1,354	194	1,114	49	1,054	624	1,297	776	1,354
Shelduck	404	706	108	424	46	680	343	714	404	714
Pintail	281	105	241	97	475	28	796	66	796	105
Shoveler	37	30	55	57	9	18	4	2	55	57

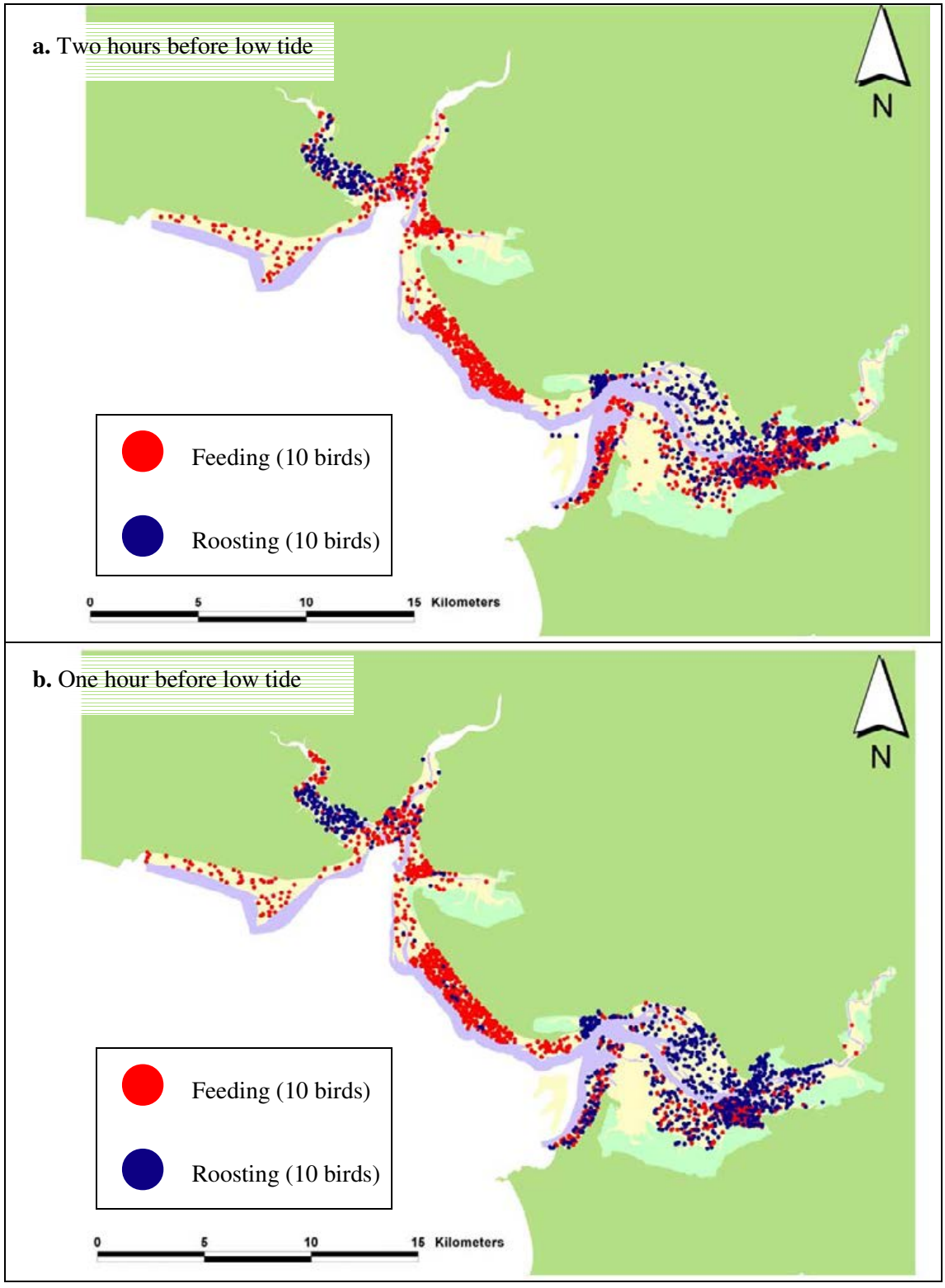
Table 3.4.2 Mean counts and density of roosting and feeding birds (birds per hectare, designated features only) for the Burry Inlet SPA and rest of Carmarthen Bay & Rivers SAC (maximum across tidal cycle).

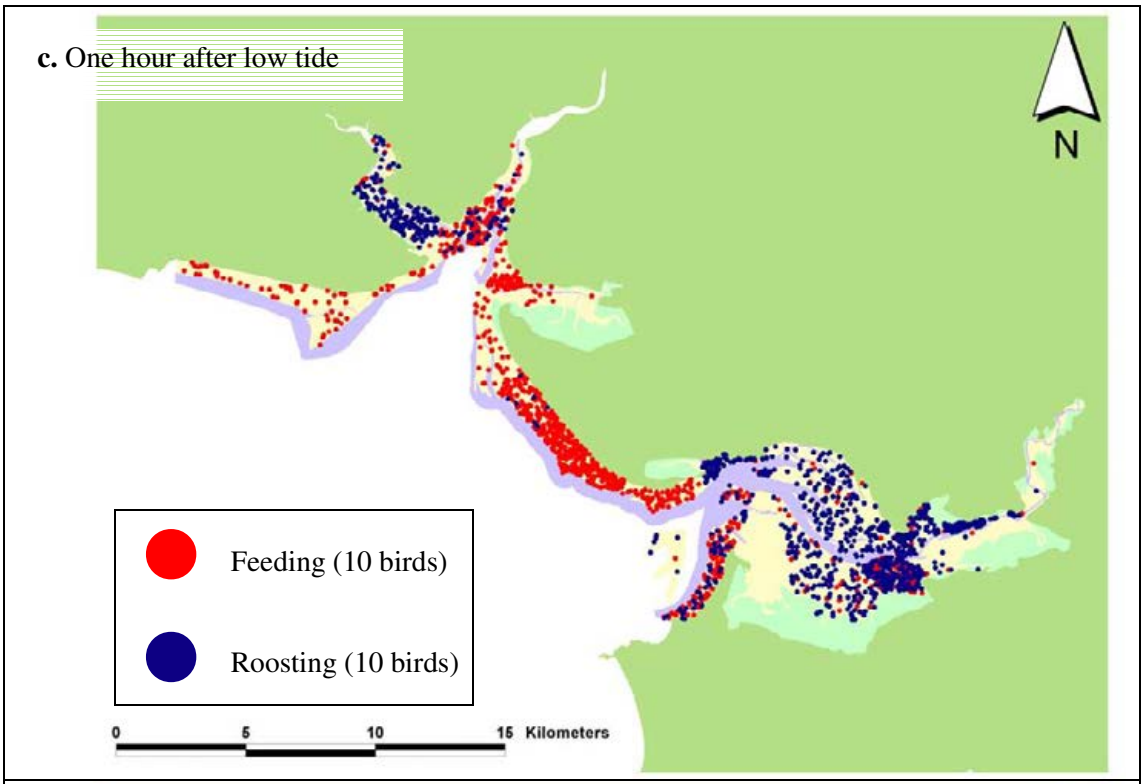
Species	Preferred habitat	Total preferred habitat (ha)	Mean roosting count	Mean feeding count	Mean roosting density	Mean feeding density
Oystercatcher	Intertidal	7,612	14,254	19,165	1.87	2.52
Knot	Intertidal	7,612	2,049	4,174	0.27	0.55
Dunlin	Intertidal	7,612	3,933	10,447	0.52	1.37
Black-tailed Godwit	Intertidal & non-tidal	9,888	161	141	0.02	0.01
Curlew	Intertidal & non-tidal	9,888	416	1,224	0.04	0.12
Shelduck	All habitats	12,524	252	710	0.02	0.06
Pintail	All habitats	12,524	454	77	0.04	0.01
Shoveler	All habitats	12,524	26	27	0.00	0.00

3.5 Relative Densities of Oystercatcher and Knot by Sector and Tidal State

Using the mean count information presented in Appendix 1, it was possible to plot the mean counts of the target species Oystercatcher and Knot, for each sector across the winter. The relative density of these species in different areas of the relevant estuaries can then be ascertained for the whole site, thus indicating important feeding and roosting areas and elucidating changes through the low tide period. These are displayed in Figures 3.5.1a-d and 3.5.2a-d.

Figure 3.5.1 Relative density of Oystercatcher on the Carmarthen Bay & Estuaries SAC throughout the low tide period. **a.** Two hours before low tide. **b.** One hour before low tide. **c.** One hour after low tide. **d.** Two hours after low tide. Red dots = feeding birds; blue dots = roosting birds. One dot = 10 birds.




c. One hour after low tide
N
Feeding (10 birds)
Roosting (10 birds)
0
5
10
15 Kilometers

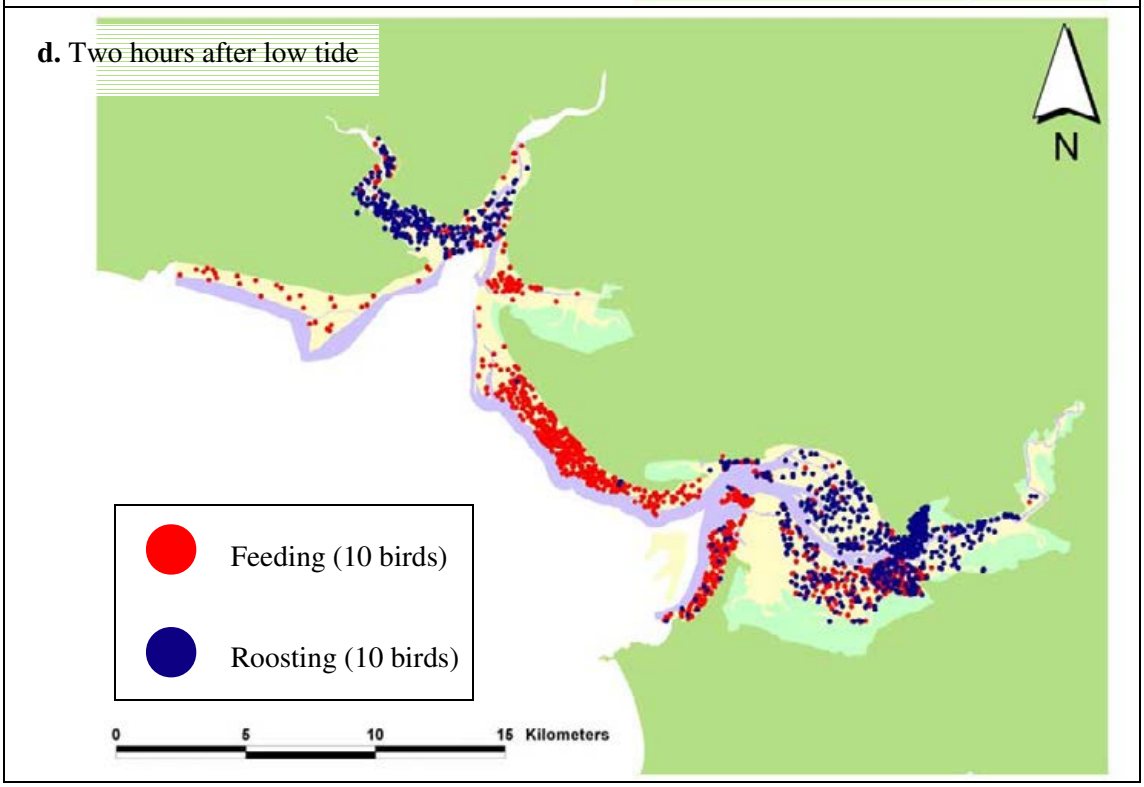
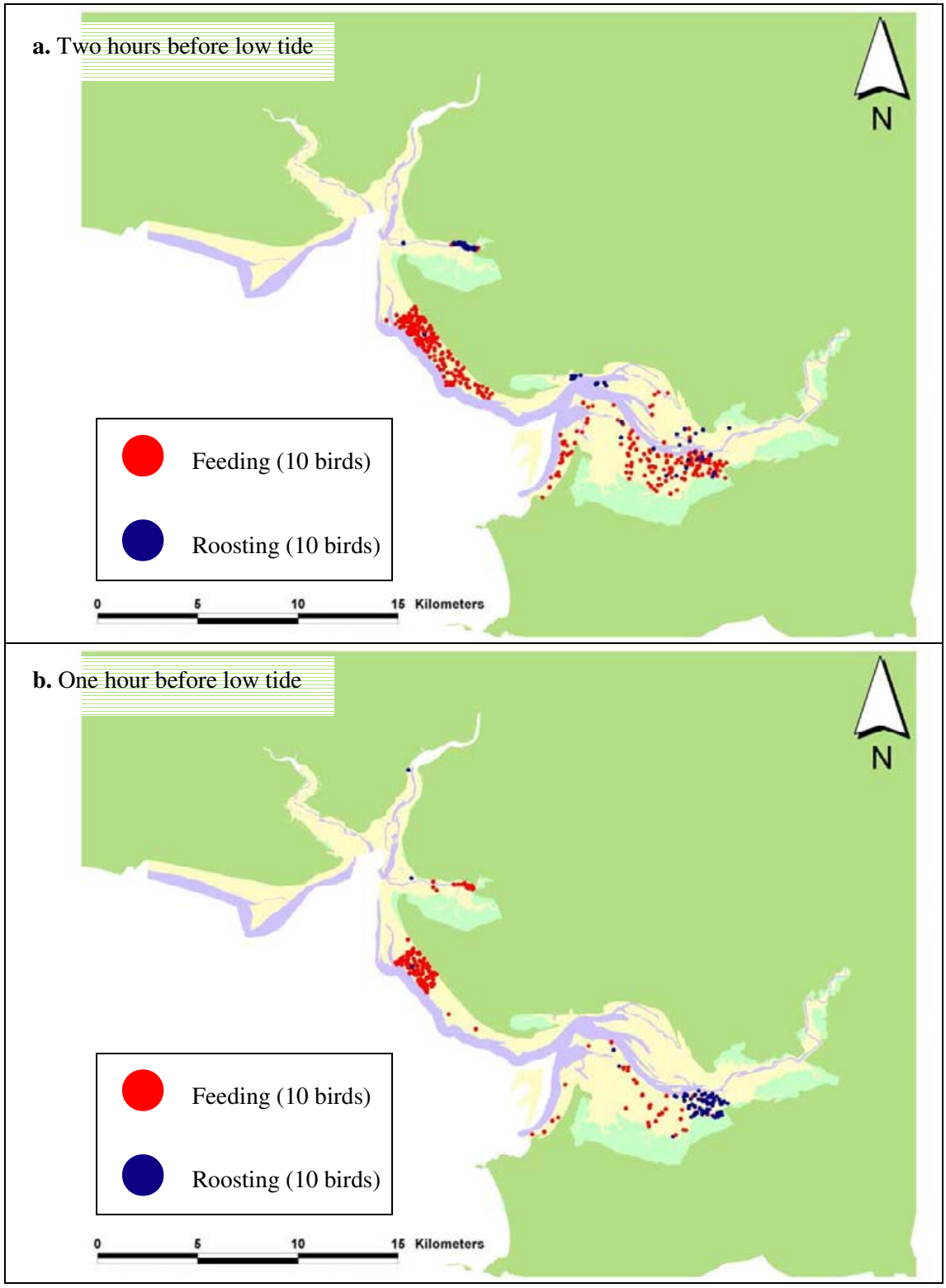
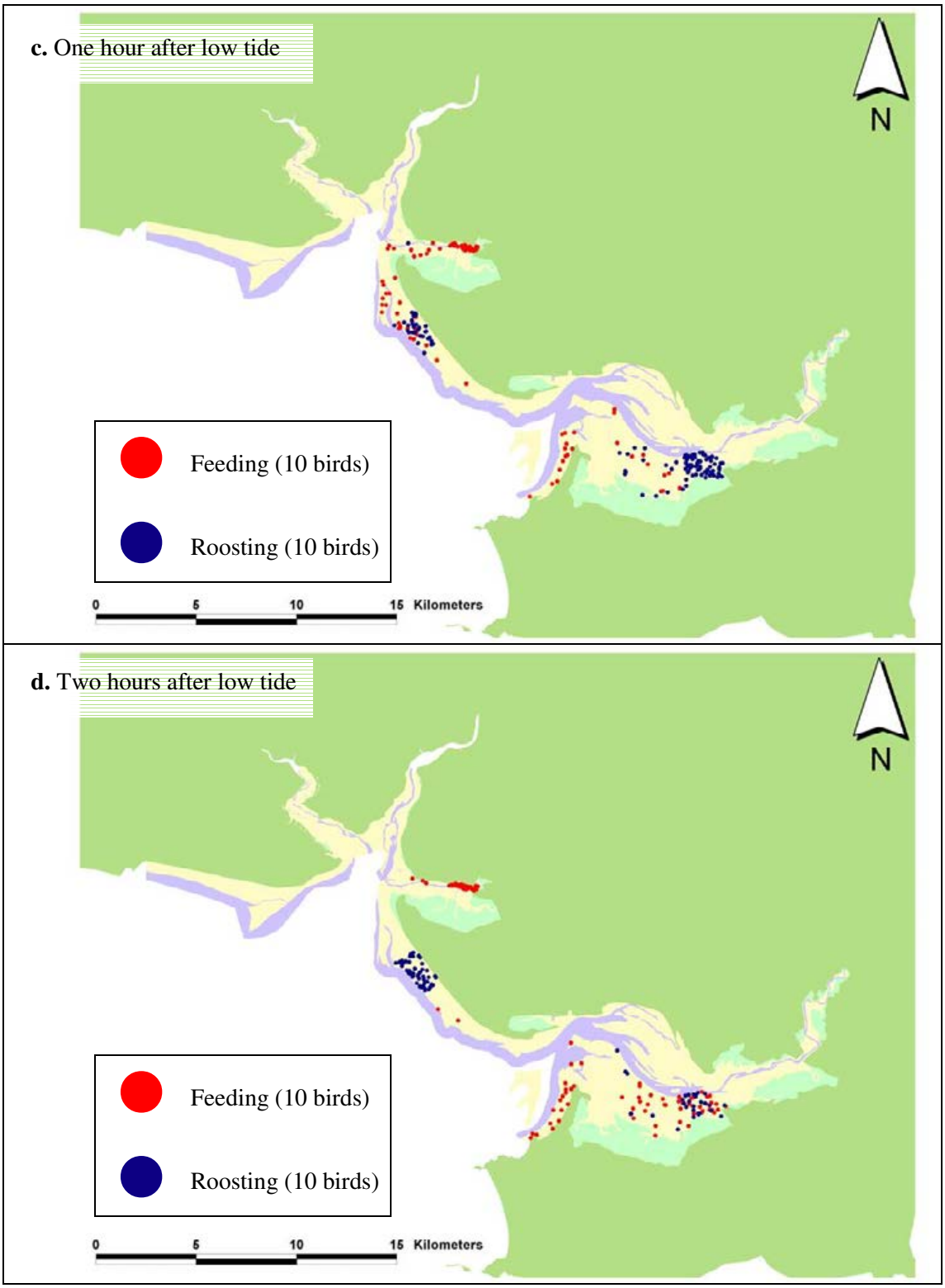

d. Two hours after low tide
N
Feeding (10 birds)
Roosting (10 birds)
0
5
10
15 Kilometers

Figure 3.5.2 Relative density of Knot on the Carmarthen Bay & Estuaries SAC throughout the low tide period. **a.** Two hours before low tide. **b.** One hour before low tide. **c.** One hour after low tide. **d.** Two hours after low tide. Red dots = feeding birds; blue dots = roosting birds. One dot = 10 birds.





3.6 Oystercatcher Behaviour Throughout the Low Tide Count Period

In order to determine how Oystercatchers use the SAC at low tide, and in particular to examine spatial and temporal changes in feeding and roosting behaviour, the proportions of birds either feeding or roosting at each of the stages of the low tide period were recorded and plotted in a spatially relevant way. From these maps it is easy to see how Oystercatcher behaviour changes both in time and space (Figures 3.6.1 – 3.6.4 a-b).

Figure 3.6.1a Proportions of Oystercatchers feeding (black) and roosting (grey) on sectors of the Pembrey Coast and Three Rivers complex two hours before low tide. Absence of a pie chart indicates absence of the species.

Figure 3.6.1b Proportions of Oystercatchers feeding (black) and roosting (grey) on sectors of the Burry Inlet two hours before low tide. Absence of a pie chart indicates absence of the species.

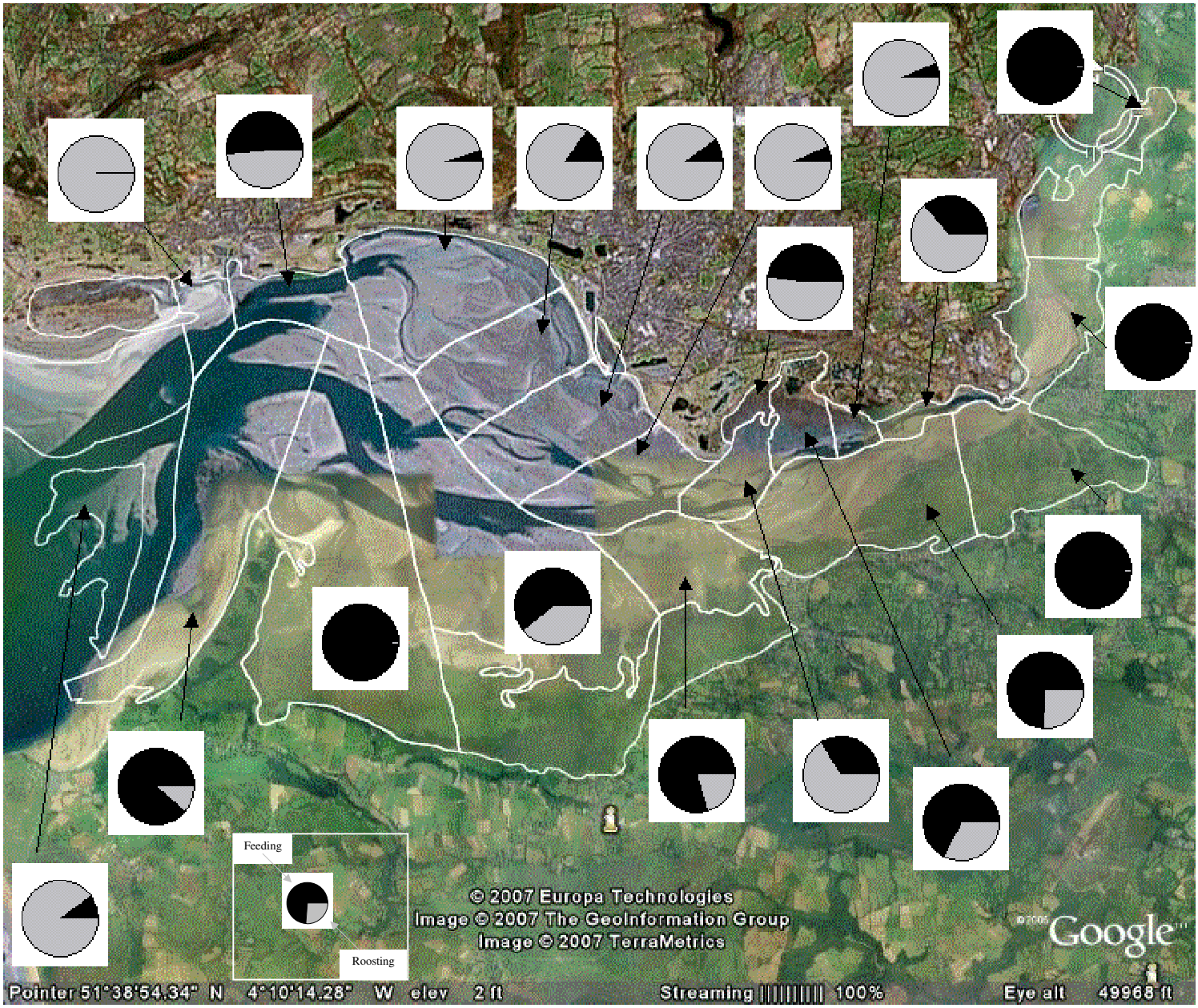


Figure 3.6.2a Proportions of Oystercatchers feeding (black) and roosting (grey) on sectors of the Pembrey Coast and Three Rivers complex one hour before low tide. Absence of a pie chart indicates absence of the species.

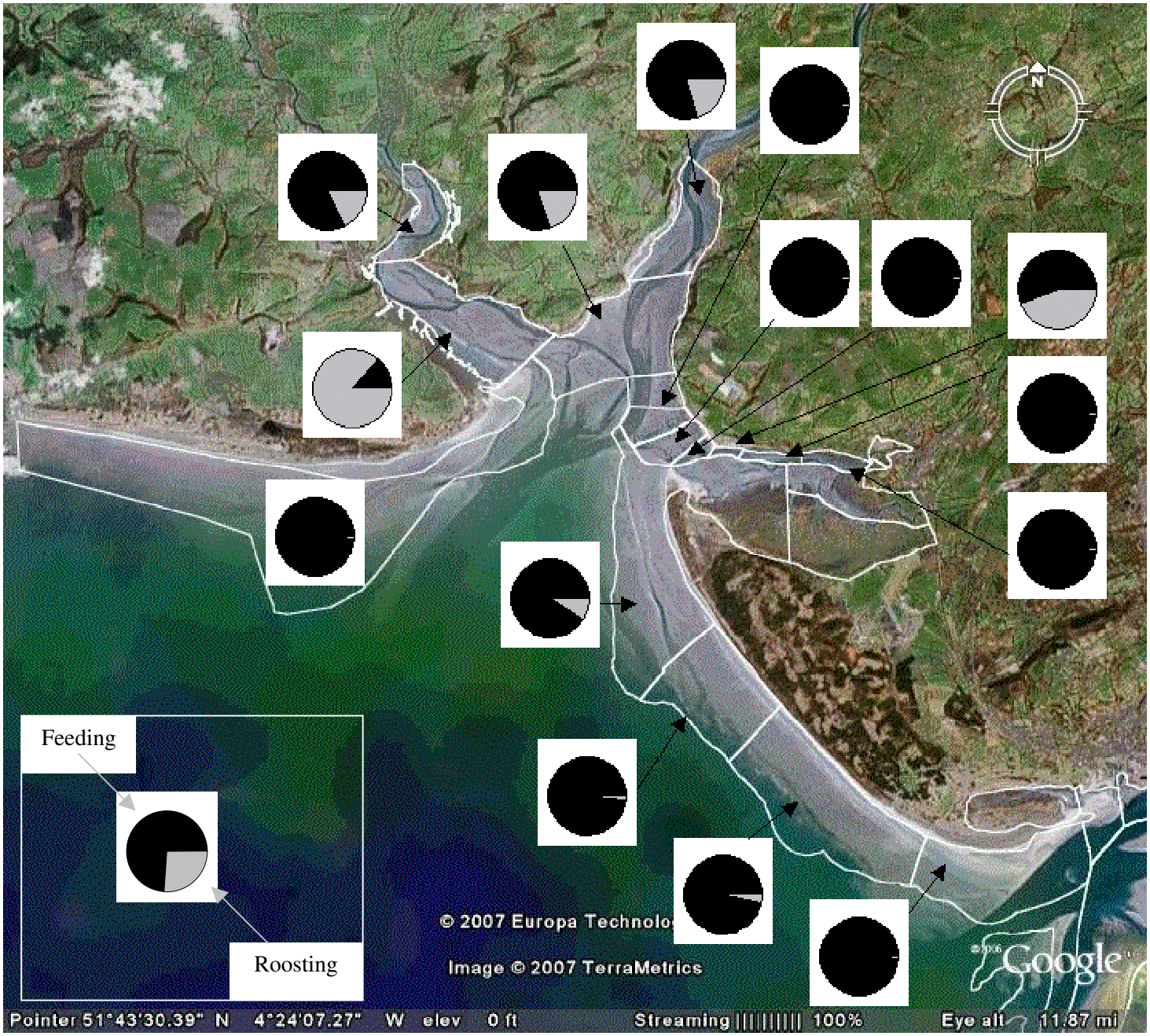


Figure 3.6.2b Proportions of Oystercatchers feeding (black) and roosting (grey) on sectors of the Burry Inlet one hour before low tide. Absence of a pie chart indicates absence of the species.

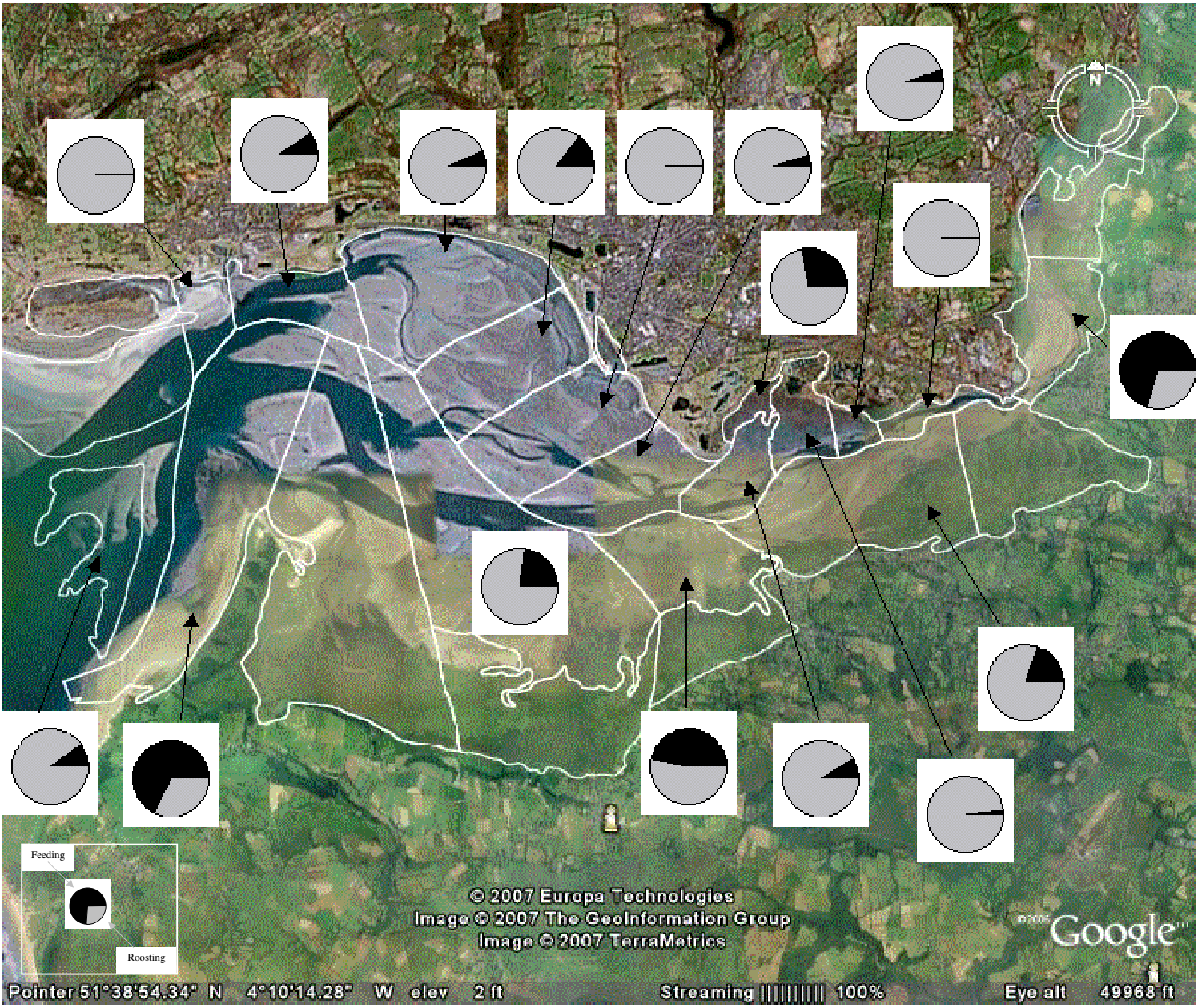


Figure 3.6.3a Proportions of Oystercatchers feeding (black) and roosting (grey) on sectors of the Pembrey Coast and Three Rivers complex one hour after low tide. Absence of a pie chart indicates absence of the species.

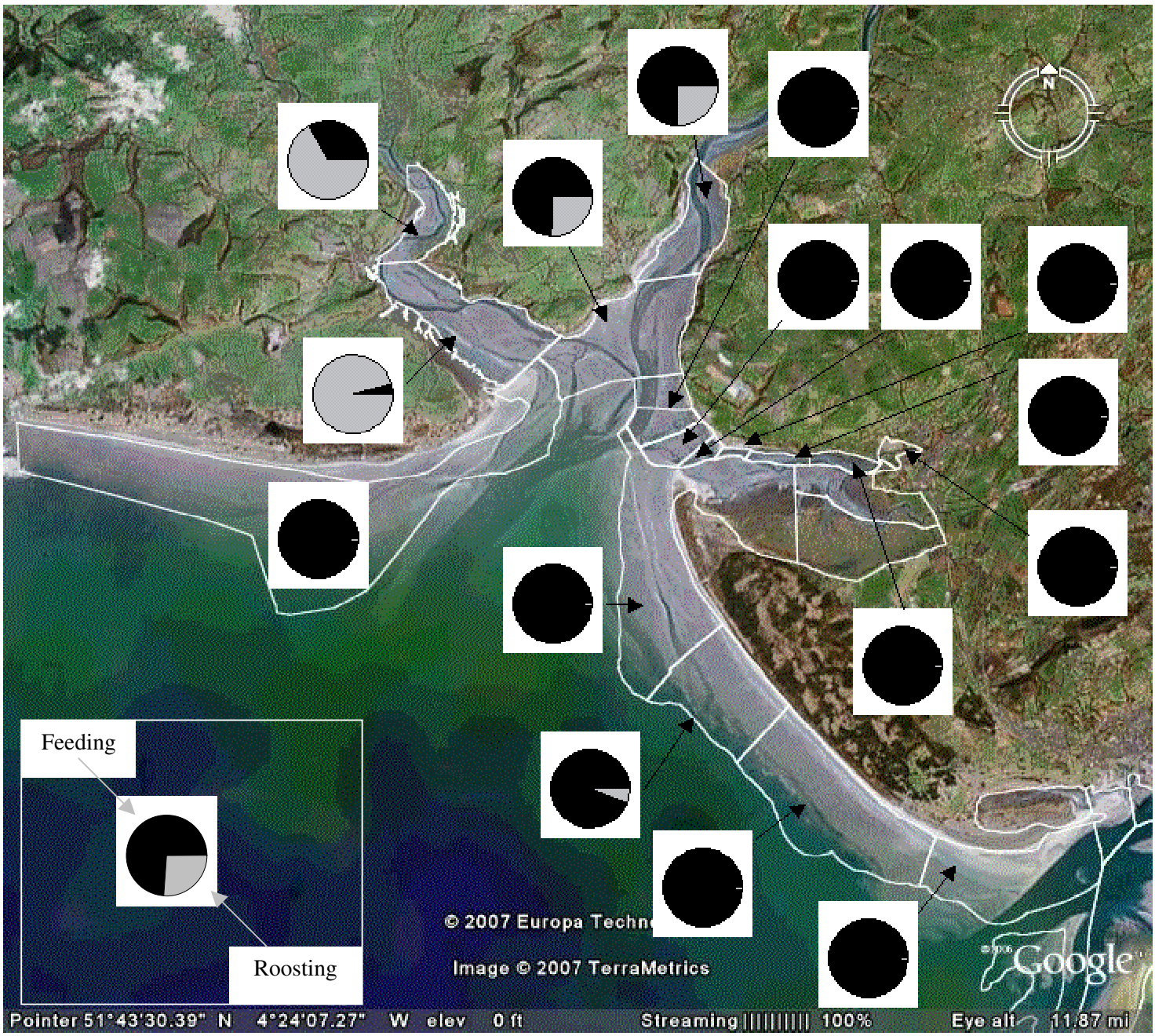


Figure 3.6.3b Proportions of Oystercatchers feeding (black) and roosting (grey) on sectors of the Burry Inlet one hour after low tide. Absence of a pie chart indicates absence of the species.

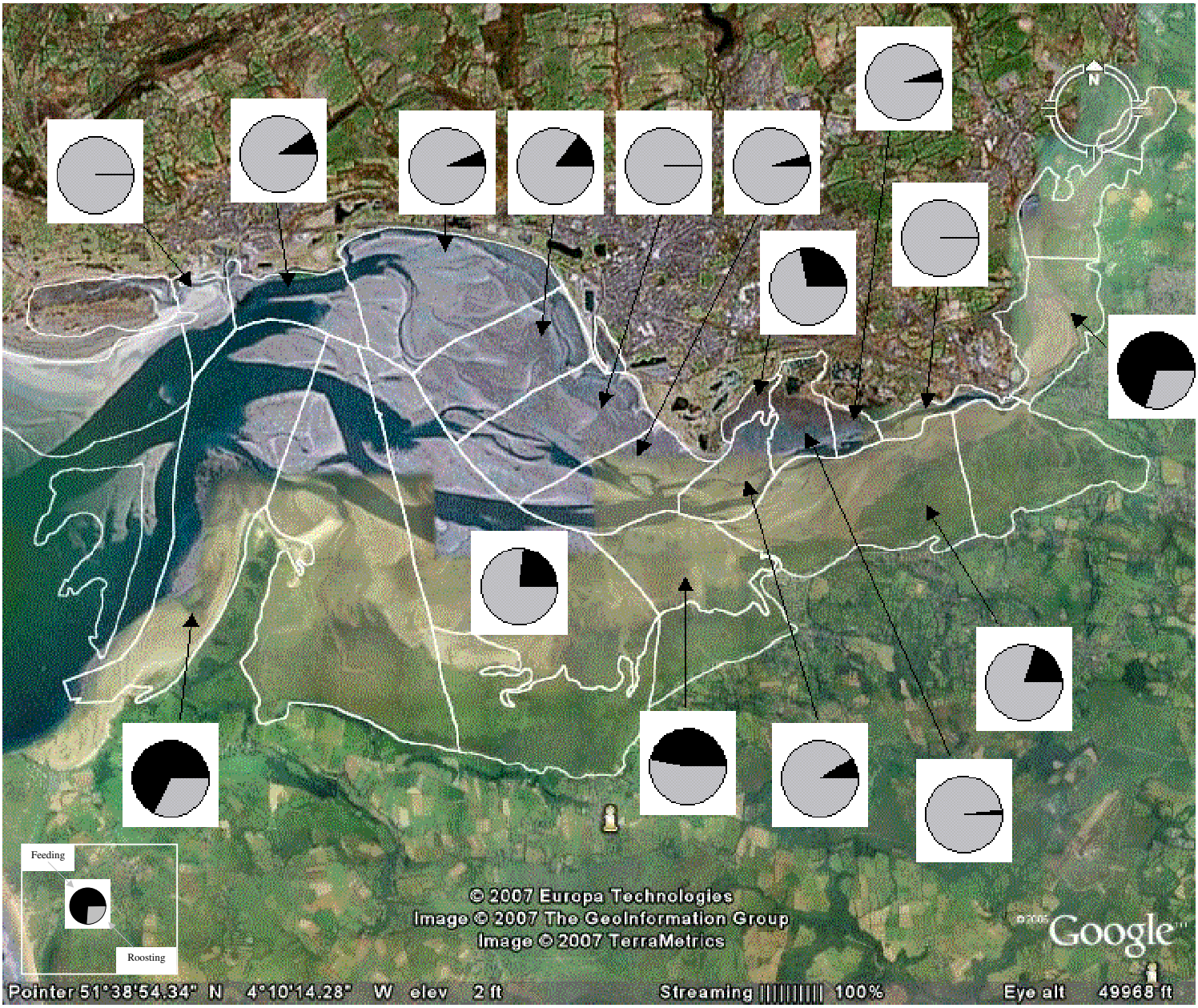


Figure 3.6.4a Proportions of Oystercatchers feeding (black) and roosting (grey) on sectors of the Pembrey Coast and Three Rivers complex two hours after low tide. Absence of a pie chart indicates absence of the species.

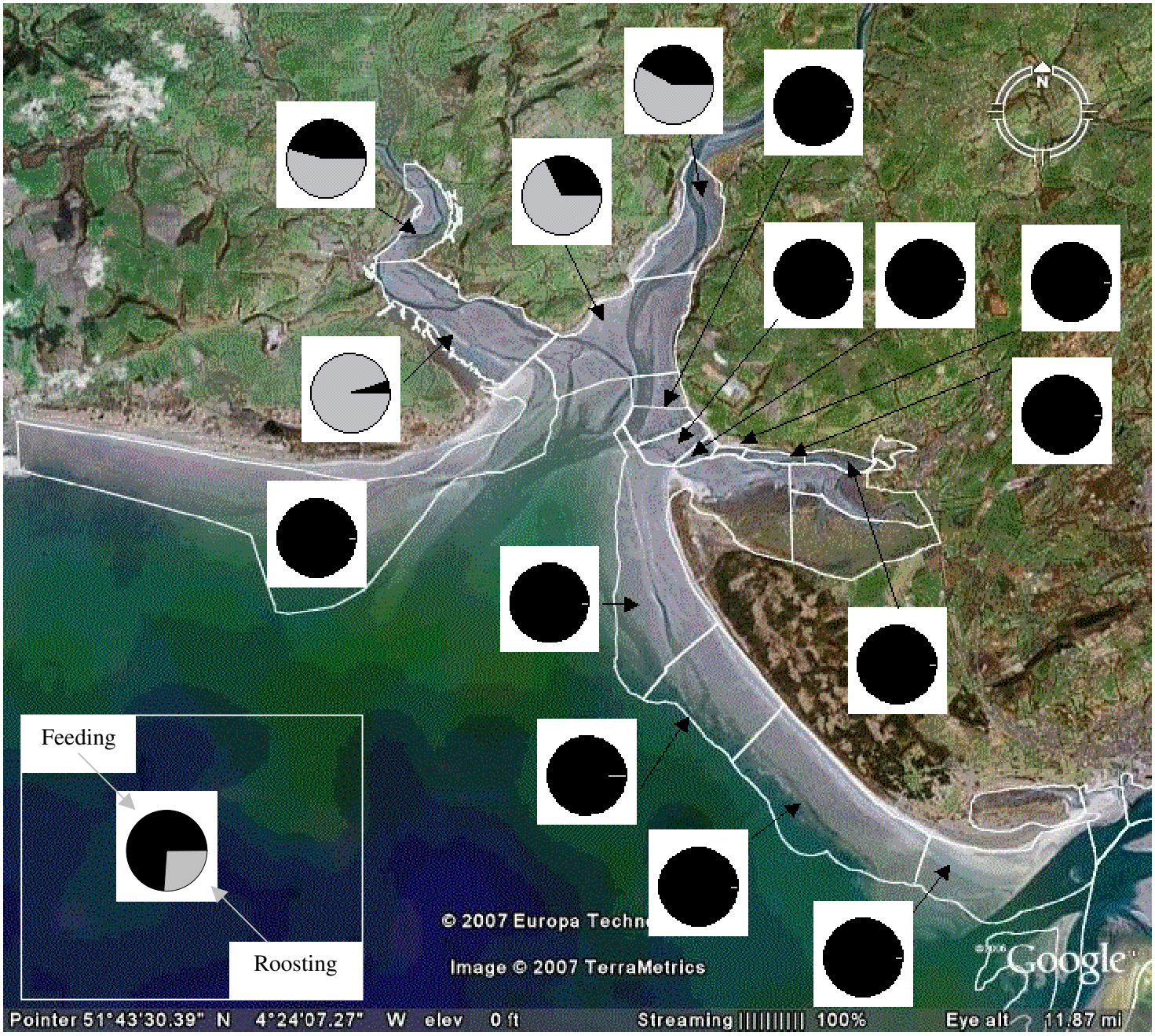
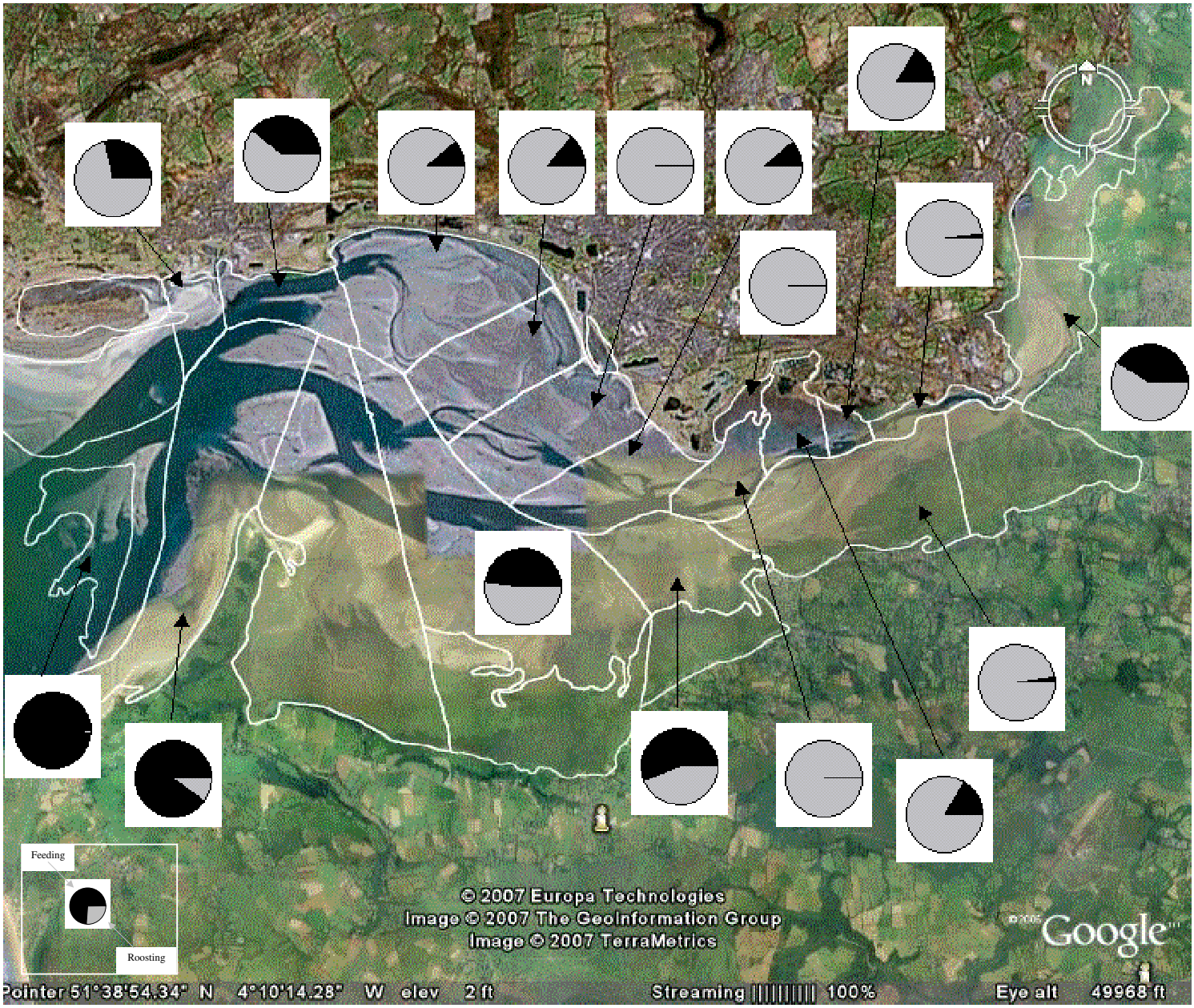


Figure 3.6.4b Proportions of Oystercatchers feeding (black) and roosting (grey) on sectors of the Burry Inlet two hours after low tide. Absence of a pie chart indicates absence of the species.



3.7 Bird Movements, Shellfishing and Sources of Obvious Disturbance

Counters recorded details of movements of birds, and where possible, related these to disturbance events. These notes were often comprehensive, and so a summary of relevant records is presented by month (Tables 3.7.1 – 3.7.4). For brevity, this has been restricted to the target species Oystercatcher and Knot.

Table 3.7.1 Oystercatcher and Knot movements and disturbance in November 2006.

Sector	Tidal state	Species	Notes
DB004	-2	OC	ca.1,600 flushed west to feed / roost
DB004	+2	OC	Flushed east by movement of fishermen / cocklers
DB009	+2	OC	2,000 east – west and onto this roost after disturbance by a Peregrine
DB013	-2	OC	Bait diggers scared birds
DB013	-1	OC	14 bait diggers towards waters edge
DB018	+2	OC	ca.1,600 east – west onto this roost from up river
DB019	+2	OC	ca.1,600 east – west onto this roost from up river
DB030	-2	OC	18 flew west
DB031	-2	OC	Most birds (except gulls) flushed by bait digger and went south. Later flushed by cocklers in Land Rovers
DB031	+1	OC	Cocklers in Land Rovers
DB033	+1	OC	At end of count two anglers with dogs disturbed most of the birds sending them into sectors DB021 and DB032
DJ002	-2	OC	96 flying west
DJ002	-1	OC	+30 flying east
DJ004	-2	OC	5 flew north
DJ004	-1	OC	5 flew south
DJ007	-2	OC	+12 flying west
DJ007	-1	OC	5 flying west
DJ007	+1	OC	10 flew south west
DJ010	-1	OC	8 flying west
DJ010	+1	OC	5 flying west
DJ011	-2	OC	17 flying south west
DJ011	+1	OC	12 flew west
DJ011	+2	OC	10 flew west
DJ012	+1	OC	14 flew in from west
DJ013	+1	KN	Land Rovers owned by mussel gatherers on scar as well as 4 bait diggers All birds kept a distance away from these
DJ013	+2	KN	Mussel pickers left driving through DJ012 & DJ011 Birds lifting and keeping distance
DJ013	-1	OC	Mussel pickers left driving through DJ012 & DJ011 Birds lifting and keeping distance
DJ013	+2	OC	50 flew north east Land Rovers owned by mussel gatherers on scar as well as 4 bait diggers All birds kept a distance away from these
DJ021	-2	OC	Slight disturbance from walkers Nearly all bird movement seems to be to occupy feeding areas exposed by falling tide
DJ022	-1	OC	20 flying east
DJ022	+2	OC	11 preening and 30 flying south

Table 3.7.2 Oystercatcher and Knot movements and disturbance in December 2006.

Sector	Tidal state	Species	Notes
DB003	-2	OC	3 wildfowlers on west river bank
DB004	-1	OC	190 flushed west
DB013	-2	KN	Birds flew south over water; 40 returned to roost in same place later
DB013	-2	OC	Small flocks flew in to roost from the east of inlet Most of the feeding birds were on rocks by sea wall and nearby mud / sand near waters edge
DB013	-1	OC	Mostly feeding but unsettled by 2 bait diggers Birds moving along water's edge away from men but not flying off
DB021	-2	OC	Two wildfowlers with dog walked into DB021 and let off two shots before leaving: disturbed some of the waders and ducks down channel
DB030	-2	OC	14 flew west into next section [DB013]
DJ003	-2	KN	600 flew east after car disturbance
DJ003	-1	KN	200 flew west
DJ003	+1	KN	20 flew east
DJ003	-2	OC	38 flew west after car disturbance
DJ003	-1	OC	65 flew west
DJ003	+1	OC	3 flew east / 100 flew west
DJ011	-2	OC	Mussel pickers present: 6 vehicles and 2 tractors; no birds within ¼ mile
DJ011	-1	OC	Mussel pickers present : + 6 vehicles and 2 tractors; no birds with ¼ mile
DJ011	+1	OC	Birds to west of mussel pickers which were still present
DJ012	-2	OC	To the east of mussel scar were mussel pickers & vehicles Cleaning & bagging machine in full swing - birds constantly lifting & resettling As well as mussel pickers at this time there were 4 bait diggers working the mussel scar
DJ012	-1	OC	Situation same as –2 hours regarding mussel pickers on scar
DJ015	-1	OC	60 flying east
DJ022	-1	OC	13 flying to ferryside
DJ023	+1	OC	Stopped feeding on the scar and formed a roost nearby

Table 3.7.3 Oystercatcher and Knot movements and disturbance in January 2007.

Sector	Tidal state	Species	Notes
DB004	-2	OC	1,100 flushed west followed later by ca.600 flushed west
DB004	-1	OC	40 flushed west; 5 bait diggers on river bed
DB013	-1	OC	14 bait diggers on mud / sand disturbed birds which moved away
DB021	-1	OC	ca. 400 flew up channel to DB032 and DB033
DB027	-2	OC	Dog and owner on beach
DB033	-2	OC	ca.1,500 flew through section DB032 up channel to section DB033
DB033	+1	OC	ca. 2,000 flew from section up channel ca. 800 flew back into section to roost later
DB033	+2	OC	Obvious shift in preferred roost sectors from section DB020 & DB021 to sections DB033 & DB027 from Dec possibly due to these sections being more sheltered during rough weather conditions
DJ001	+1	OC	40 fly east
DJ002	-1	OC	11 flying west
DJ003	-2	KN	3 bait diggers: birds kept safe distance Movement generally north west to south east along coast
DJ003	-1	KN	Movement at first north west to south east then south east to north west along tideline
DJ003	+1	KN	Movement generally south east to north west along tideline
DJ003	+2	KN	Movement south east to north west parallel to tideline
DJ003	-2	OC	3 bait diggers: birds kept safe distance Movement generally north west to south east along coast
DJ003	-1	OC	Movement at first north west to south east then south east to north west along tideline
DJ003	+1	OC	Movement generally south east to north west along tideline
DJ003	+2	OC	Movement south east to north west parallel to tideline
DJ007	-1	KN	70 flying
DJ010	-1	KN	20 flying west to east
DJ011	-2	KN	Some disturbance on upper shoreline from two men with vehicle picking mussels No birds in this area
DJ011	-2	OC	10 flew west to east Some disturbance on upper shoreline from two men with vehicle picking mussels No birds in this area
DJ011	-1	OC	Some disturbance on upper shoreline from two men with vehicle picking mussels No birds in this area
DJ011	+1	OC	Some disturbance on upper shoreline from two men (mussel pickers) driving away in vehicle
DJ012	-2	KN	Two mussel pickers on scar: birds keep safe distance: no vehicles
DJ012	-1	KN	Flew in from west
DJ012	-2	OC	Two mussel pickers on scar: birds keep safe distance: no vehicles
DJ012	-1	OC	40 fly west
DJ012	+1	OC	60 fly east
DJ013	-2	OC	35 fly east
DJ013	-1	OC	20 fly east
DJ013	+1	OC	20 fly east
DJ015	-2	OC	20 fly south
DJ015	-1	OC	15 fly south east
DJ015	+1	OC	30 fly south east
DJ022	-2	OC	80 flying across the river

Table 3.7.4 Oystercatcher and Knot movements and disturbance in February 2007.

Sector	Tidal state	Species	Notes
DB004	-2	OC	700 flew west early in tidal stage
DB004	-1	OC	Cockle picker present
DB004	+1	OC	3 bait diggers on river bed
DB004	+2	OC	3 bait diggers on river bed
DB006	-2	KN	Since the cessation of cockle picking in the estuary at sections DB006 and DB009 there has been a build up of clumps of cockle shells covering large areas These clumps have been colonised by mussels (lightly) and sparsely by bladder wrack, also on the upper shore
DB006	-1	KN	Disturbance by a bait / shellfish collector. The birds did not return for the rest of the count even though the collector had departed after a short time
DB006	-2	OC	See above
DB006	-1	OC	Disturbance by a bait / shellfish collector. The birds did not return for the rest of the count even though the collector had departed after a short time
DB009	-2	KN	See above
DB009	-2	OC	See above
DB013	-2	OC	2 mussel pickers and 3 bait diggers
DB013	-1	OC	14 bait diggers on wet mud / sand and 4 anglers at water's edge
DB013	+1	OC	2 flew from west
DB013	+2	OC	5 bait diggers on mud / sand. A 4x4 drove down onto the sand and continued near the water's edge through western edge of DB013 into DB012 and DB011. It did not scare any birds that I could see; had no trailer and had no purpose other than off road driving
DB027	+1	OC	3 youths walking on shore; 2 fishing
DB027	+2	OC	2 youths on shore fishing
DB029	-1	KN	Birds disturbed by walkers
DB029	+1	KN	Birds disturbed a little by walkers
DB029	-1	OC	Birds disturbed by walkers
DB029	+1	OC	Birds disturbed a little by walkers
DB030	-2	OC	2 flew east
DB030	-1	OC	5 flew in from east
DB031	-2	OC	Flushed to DB030 by two bait diggers and 30 dog walkers
DB032	-2	OC	5 bait diggers hence low numbers
DJ002	-2	OC	430 flying north
DJ003	-2	KN	Movements of birds both north west to south east and south east to north west along beach
DJ003	-1	KN	Lugworm vehicle and 3 diggers disturbed birds: main movement south east to north west
DJ003	+1	KN	Disturbance from one lugworm vehicle and one netsman's vehicle driving along tideline. General movement south east to north west
DJ003	-2	OC	Movements of birds both north west to south east and south east to north west along beach
DJ003	-1	OC	Lugworm vehicle and 3 diggers disturbed birds: main movement south east to north west
DJ003	+1	OC	Disturbance from one lugworm vehicle and one netsman's vehicle driving along tideline. General movement south east to north west
DJ003	+2	OC	Lugworm vehicle then netsman's vehicle drove along the tideline disturbing birds which entered DJ004 General movement south east to north west and away from vehicles

Table 3.7.4 Continued.

Sector	Tidal state	Species	Notes
DJ004	+1	OC	Flocks lifted and resettled following 1 RAF jet fly past
DJ011	-2	OC	Some minor disturbance from bait digger
DJ013	-1	OC	17 fly east
DJ013	+2	OC	15 fly south
DJ015	-2	OC	3 professional bait pumpers moving all over river edge
DJ015	-1	OC	Bait pumpers still in action along river edge
DJ015	+1	OC	Bait pumpers left to go to Pembrey sands
DJ021	-2	KN	Some disturbance by walkers and dogs on the west side of the estuary
DJ021	-1	KN	Continued disturbance by walkers, dogs on west shore of the estuary
DJ021	-2	OC	Some disturbance by walkers and dogs on the west side of the estuary
DJ021	-1	OC	Continued disturbance by walkers, dogs on west shore of the estuary
DJ021	+1	OC	Continued disturbance by walkers/dogs
DJ021	+2	OC	Continued disturbance by people and dogs but probably not affecting the birds as most are on mid-estuary sand banks and channels
DJ025	-2	OC	Increasingly 3 or 4 seen on grassland behind dunes feeding
DJ025	+2	OC	Some oystercatcher regularly seen feeding on grass behind beach in Pendine

3.8 Non SPA Feature Species

Many species of waterbird were recorded on the surveys which were not considered in detail in this report. Data on these species will be provided to CCW and a list of such species appears below.

Table 3.8.1 Species of waterbird recorded across all surveys. *SPA features.

Species	Scientific name	No. of months recorded
Bar-tailed Godwit	*Limosa lapponica*	4
Black-headed Gull	*Larus ridibundus*	4
Black-tailed Godwit*	*Limosa limosa*	4
Cormorant	*Phalacrocorax carbo*	4
Canada Goose	*Branta canadensis*	1
Common Gull	*Larus canus*	4
Common Sandpiper	*Actitis hypoleucos*	2
Curlew*	*Numenius arquata*	4
Dark-bellied Brent Goose	*Branta bernicla bernicla*	4
Dunlin*	*Calidris alpina*	4
Spotted Redshank	*Tringa erythropus*	2
Little Egret	*Egretta garzetta*	4
Gadwall	*Anas strepera*	1
Great Black-backed Gull	*Larus marinus*	4
Goosander	*Mergus merganser*	1
Great Crested Grebe	*Podiceps cristatus*	4
Greylag Goose	*Anser anser*	2
Greenshank	*Tringa nebularia*	4
Goldeneye	*Bucephala clangula*	3
Golden Plover	*Pluvialis apricaria*	3
Grey Plover	*Pluvialis squatarola*	4
Grey Heron	*Ardea cinerea*	4
Herring Gull	*Larus argentatus*	4
Unidentified small wader	*Calidris/Arenaria/Charadrius sp*	1
Knot*	*Calidris canutus*	4
Lapwing	*Vanellus vanellus*	4
Lesser Black-backed Gull	*Larus fuscus*	4
Little Grebe	*Tachybaptus ruficollis*	2
Long-tailed Duck	*Clangula hyemalis*	1
Mallard	*Anas platyrhynchos*	4
Oystercatcher*	*Haematopus ostralegus*	4
Purple Sandpiper	*Calidris maritima*	1
Pintail*	*Anas acuta*	4
Redshank	*Tringa totanus*	4
Red-breasted Merganser	*Mergus serrator*	4
Ringed Plover	*Charadrius hiaticula*	4
Ruff	*Philomachus pugnax*	1
Snipe	*Gallinago gallinago*	2
Scaup	*Aythya marila*	1
Sanderling	*Calidris alba*	4
Shelduck*	*Tadorna tadorna*	4
Shoveler*	*Anas clypeata*	4
Slavonian Grebe	*Podiceps auritus*	1
Teal	*Anas crecca*	4

Table 3.8.1 Continued.

Species	Scientific name	No. of months recorded
Turnstone	*Arenaria interpres*	4
Tufted Duck	*Aythya fuligula*	1
Unidentified wader		1
Unidentified gull	*Larinae sp*	1
Unidentified large gull		2
Wigeon	*Anas penelope*	4

4. DISCUSSION

Comprehensive counts of 42 sectors covering 12,524 ha of habitat was surveyed over the winter months November – February. This is the first time the intertidal area of the Carmarthen Bay & Estuaries SAC has been surveyed as a whole at low tide. This was a considerable achievement by the counters involved, especially given that daylight and weather conditions were not favourable through much of January.

A wealth of both quantitative and qualitative information was collected, that will contribute towards CCW making important decisions regarding shellfishing and other practices on the Burry Inlet SPA and the wider Carmarthen Bay & Estuaries SAC.

4.1 Temporal Changes in Knot and Oystercatcher Behaviour Through the Low Tide Period

As perhaps might be expected, the mean proportions of Knot and Oystercatcher feeding and roosting through the period from two hours before low tide to two hours after low tide changed pronouncedly. Both species showed a decreasing tendency to feed and increasing tendency to roost as time progressed.

Mean densities of Oystercatcher feeding and roosting at each tidal stage are shown in Table and Figure 4.1.1, Knot in Table and Figure 4.1.2. Given that greater numbers of birds feed earlier in the tidal stage, there would appear to be potential for temporal avoidance by shellfishers of feeding areas at times when bird densities are highest, thus reducing conflicts between birds and people as has been considered at sites such as Morecambe Bay (Banks 2006). However, it should be noted that even two hours after low tide, Oystercatchers in particular are likely to remain feeding at considerable densities, especially along the Pembrey Coast and Gwendraeth River area. It is possible that this area acts as a supplementary feeding area for birds suffering from competition interference earlier in the tidal period on other sectors (Caldow *et al.* 1999). Mussel-gathering, and to a lesser extent cockling, either involving people or people with machinery, undoubtedly creates proximate disturbance, as this study has revealed.

Table 4.1.1 Mean density of Oystercatcher feeding and roosting at two hours before low tide (-2) through to two hours after low tide (+2)

Tidal stage	Feeding	Roosting
-2	1.97	0.86
-1	1.59	1.23
+1	1.47	1.29
+2	1.36	1.35

Table 4.1.2 Mean density of Knot feeding and roosting at two hours before low tide (-2) through to two hours after low tide (+2)

Tidal stage	Feeding	Roosting
-2	0.50	0.08
-1	0.22	0.09
+1	0.15	0.15
+2	0.17	0.10

The mean total number of feeding and roosting Oystercatcher within the whole Burry Inlet and Three Rivers complex remained fairly stable throughout the tidal cycle, suggesting that most of the birds feeding within the complex also roost there (Figure 4.1.1). However, Knot numbers decreased after on hour before low tide, implying that at this stage of the cycle, birds either depart to feed and / or roost

elsewhere, or that they are in areas not visible to counters on the Burry Inlet site complex (Figure 4.1.2).

Figure 4.1.1 Mean density of Oystercatcher feeding (unbroken line) and roosting (dashed line) against mean total numbers counted (bars) through the tidal cycle from two hours before low tide (-2) through to two hours after low tide (+2)

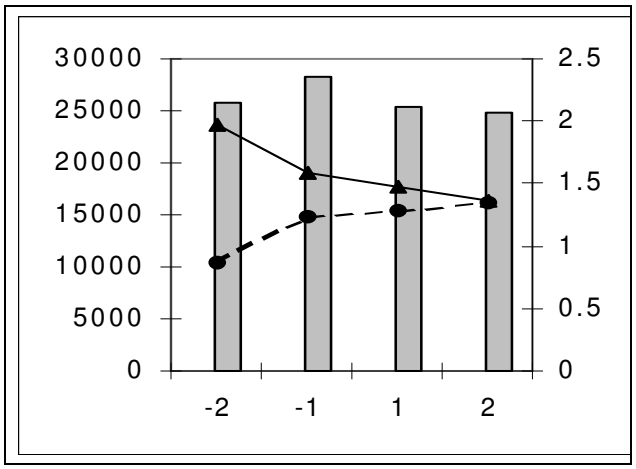
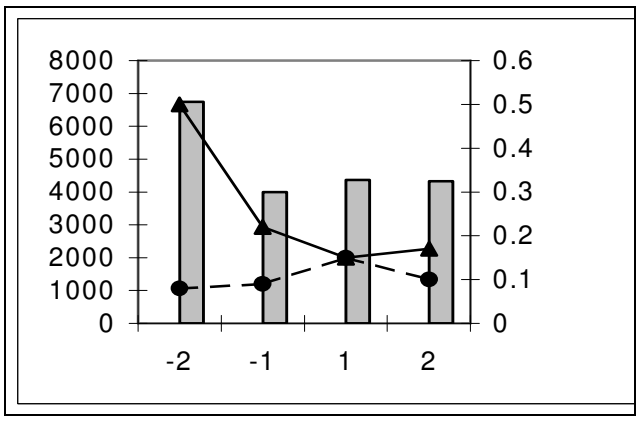


Figure 4.1.2 Mean density of Knot feeding (unbroken line) and roosting (dashed line) against mean total numbers counted (bars) through the tidal cycle from two hours before low tide (-2) through to two hours after low tide (+2)



4.2 Spatial Changes in Knot and Oystercatcher Behaviour Through the Low Tide Period

Although large numbers of Knot were recorded feeding on some sectors (*e.g.* a mean of 1,217 at a density of 5.27 birds per ha on DJ003), most feeding densities were comparatively low even one hour after low tide (128 birds at 0.55 birds per ha on the aforementioned sector). Highest feeding densities were on the Pembrey Coast, Gwendraeth River and the south Burry Inlet. However, very few Knot were recorded as roosting; the only notable flock being 479 on sector DJ003. The presence of relatively high numbers in this sector suggests that some of those birds initially feeding in high densities on this sector were subsequently able to roost in the same area.

There does not appear to be a distinct pattern of movement of Oystercatcher around the site through the low tide period, although movements were frequently recorded and some in large quantities. Many sector densities, especially on the Pembrey Coast, were very similar throughout the study duration. However, some sectors showed large differences in counts of feeding and roosting birds between tidal stages. On the Three Rivers complex, it was apparent that sector densities of feeding Oystercatcher decreased as time progressed. Sectors DJ015, DJ022, DJ024 and DJ025 all showed at least a halving and in some cases a threefold reduction in mean densities between two hours before and two hours after low tide. Other sectors with a similar pattern included DJ001 at Pembrey and DB004 on the south Burry.

Changes in mean densities of roosting birds were most apparent on the north bank of the Burry Inlet. As the tidal cycle progressed, increasing numbers of Oystercatchers were recorded as roosting. In particular, the Llanelli area (sectors DB020, DB021, DB027 and DB032) witnessed great increases in numbers of roosting birds between two hours before and two hours after low tide; mean densities on DB020 rose from 1.56 to 11.74 birds per ha.

Low numbers of Oystercatchers were recorded feeding on these sectors, and so it seems likely that birds feeding across the area return to the north of the Burry Inlet to roost. Radio tracking or similar would be a useful method to measure movements between feeding sites and roosts.

4.3 Interchange between Burry Inlet SPA and remainder of the SAC

Examining summed mean counts of Oystercatcher throughout the tidal cycle, it is notable how consistent the total number of birds on the SAC as a whole remains, never fluctuating by more than 469 between successive tidal stages (Table 4.3.1). If we arbitrarily assume that the complex is therefore a 'closed system', with negligible movements between neighbouring sites, then there appear to be some counterbalancing increases and decreases between the Burry Inlet SPA (sectors prefixed 'DB') and the Three Rivers complex (prefixed 'DJ': Table 4.3.1), albeit on a relatively small scale. For instance, between two hours before low tide and one hour before, the mean total number of Oystercatcher on the Burry Inlet decreased by 837, whilst that on the Three Rivers increased by 736; similarly, between one and two hours after low tide, Oystercatcher numbers rose by 1,186 on the Burry Inlet and decreased by 1,550 on the Three Rivers.

Table 4.3.1 Summed mean counts of Oystercatcher for the Burry Inlet SPA and Three Rivers complex. Tidal stage is relative to Low Tide.

Tidal stage	Burry Inlet			Three Rivers			Site total
	Feeding	Roosting	Total	Feeding	Roosting	Total	
-2	7,056	5,021	12,077	7,861	1,536	9,397	**21,474**
-1	3,822	7,418	11,240	8,245	1,888	10,133	**21,373**
+1	3,277	7,671	10,948	7,859	2,097	9,956	**20,904**
+2	4,546	7,588	12,134	5,782	2,624	8,406	**20,540**

The same pattern is not evident for Knot; numbers of this species across the whole site dropped at one hour before low tide, and thereafter declined more gradually (Table 4.3.2).

Table 4.3.2 Summed mean counts of Knot for the Burry Inlet SPA and Three Rivers complex. Tidal stage is relative to Low Tide.

Tidal stage	Burry Inlet			Three Rivers			Site total
	Feeding	Roosting	Total	Feeding	Roosting	Total	
-2	1,549	310	1,859	2,238	270	2,508	**4,367**
-1	359	691	1,050	1,301	27	1,328	**2,378**
1	240	795	1,035	872	326	1,198	**2,233**
2	617	293	910	659	483	1,142	**2,052**

Most of the bird movements recorded by surveyors on this study were in response to disturbance events, although movements of large numbers of Oystercatchers west from sectors of the Burry Inlet were also recorded. Notes from sector DB004, on the south Burry, recorded between 700 and 1,700 Oystercatcher flying west in the early tidal stage in most months. It was also relatively common to record birds flying east from sectors of the Three Rivers complex, both pieces of evidence implying some movement within the site as a whole. However, across a site as large as the Carmarthen Bay & Rivers SAC, it is very difficult for ground-based observers to pinpoint movements between spatially discrete areas, especially as there may be unseen movement away from or into the site.

In order to fully understand movements of birds between the Burry Inlet SPA and the neighbouring Pembrey Coast and Three Rivers complex, it would be necessary for radio-tracking or similar to take place. If such a method was employed, it should be considered that birds could also move to and from other nearby locations such as Swansea Bay.

4.4 Disturbance Issues

The main sources of disturbance to feeding and roosting Knot and Oystercatcher were shellfishing and bait digging, and recreational disturbance (including wildfowling, walking, dog walking and off-roading). Lesser sources of disturbance included natural predators (Peregrine Falcon *Falco peregrinus*) and RAF activity.

Evidence of shellfishing (especially mussel extraction) was recorded on both the Burry Inlet and Three Rivers complex in November and on the Three Rivers complex alone in December and January. In February, the largest disturbance issue was from bait digging, with both mechanical and non-mechanical operations occurring.

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5. APPENDIX 1

5.1 Feeding Birds Two Hours Before Low Tide

Table 5.1.1. Peak and mean densities (birds per hectare) of feeding Oystercatchers two hours before low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB001	Intertidal	21	1	0.05	0	0.01
DB003	Intertidal	102	56	0.55	31	0.30
DB004	Intertidal	316	2237	7.08	1841	5.82
DB005	Intertidal	82	55	0.67	21	0.25
DB006	Intertidal	238	3100	13.03	1734	7.29
DB009	Intertidal	823	1380	1.68	900	1.09
DB012	Intertidal	55	3	0.05	1	0.02
DB013	Intertidal	47	258	5.49	133	2.82
DB018	Intertidal	286	115	0.40	29	0.10
DB019	Intertidal	168	115	0.68	30	0.18
DB020	Intertidal	117	370	3.16	93	0.79
DB021	Intertidal	0	202	(6.12)	93	(2.83)
DB027	Intertidal	25	32	1.28	20	0.80
DB028	Intertidal	207	12	0.06	3	0.01
DB029	Intertidal	344	1854	5.39	1731	5.03
DB030	Intertidal	313	38	0.12	9	0.03
DB031	Intertidal	251	210	0.84	67	0.27
DB032	Intertidal	42	537	12.79	209	4.98
DB033	Intertidal	21	69	3.29	41	1.94
DB034	Intertidal	635	70	0.11	70	0.11
DJ001	Intertidal	219	225	1.03	75	0.34
DJ002	Intertidal	359	4010	11.17	2761	7.69
DJ003	Intertidal	231	1924	8.33	1261	5.46
DJ004	Intertidal	516	1471	2.85	405	0.79
DJ007	Intertidal	22	45	2.05	11	0.51
DJ010	Intertidal	15	40	2.67	14	0.95
DJ011	Intertidal	5	280	56.00	88	17.65
DJ012	Intertidal	16	505	31.56	280	17.50
DJ013	Intertidal	56	700	12.50	471	8.41

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DJ015	Intertidal	85	472	5.55	181	2.13
DJ021	Intertidal	150	139	0.93	108	0.72
DJ022	Intertidal	340	2211	6.50	1176	3.46
DJ023	Intertidal	115	150	1.30	112	0.97
DJ024	Intertidal	328	325	0.99	296	0.90
DJ025	Intertidal	826	1050	1.27	622	0.75

Table 5.1.2 Peak and mean densities (birds per hectare) of feeding Knot two hours before low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB004	Intertidal	316	2	0.01	1	0.00
DB006	Intertidal	238	1130	4.75	578	2.43
DB009	Intertidal	823	1500	1.82	610	0.74
DB019	Intertidal	168	100	0.60	25	0.15
DB029	Intertidal	344	879	2.56	272	0.79
DB031	Intertidal	251	250	1.00	63	0.25
DJ001	Intertidal	219	3	0.01	1	0.00
DJ002	Intertidal	359	2120	5.91	716	1.99
DJ003	Intertidal	231	1875	8.12	1217	5.27
DJ004	Intertidal	516	70	0.14	21	0.04
DJ007	Intertidal	22	575	26.14	150	6.81
DJ008	Intertidal	2	475	237.50	119	59.38
DJ010	Intertidal	15	14	0.93	4	0.23
DJ011	Intertidal	5	5	1.00	2	0.40
DJ012	Intertidal	16	11	0.69	3	0.17
DJ013	Intertidal	56	17	0.30	4	0.08
DJ015	Intertidal	85	5	0.06	1	0.01

5.2 Feeding Birds One Hour Before Low Tide

Table 5.2.1 Peak and mean densities (birds per hectare) of feeding Oystercatchers one hour before low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB003	Intertidal	102	45	0.44	28	0.28
DB004	Intertidal	316	850	2.69	235	0.74
DB006	Intertidal	238	3300	13.87	1379	5.79
DB009	Intertidal	823	1800	2.19	788	0.96
DB011	Intertidal	25	1	0.04	1	0.04
DB012	Intertidal	55	1	0.02	0	0.01
DB013	Intertidal	47	356	7.57	99	2.11
DB018	Intertidal	286	4	0.01	1	0.00
DB019	Intertidal	168	83	0.49	26	0.16
DB020	Intertidal	117	100	0.85	35	0.30
DB021	Intertidal	0	180	(5.45)	47	(1.43)
DB027	Intertidal	25	2	0.08	1	0.04
DB029	Intertidal	344	1591	4.63	973	2.83
DB030	Intertidal	313	377	1.20	127	0.41
DB031	Intertidal	251	100	0.40	35	0.14
DB032	Intertidal	42	4	0.10	1	0.02
DB033	Intertidal	21	123	5.86	46	2.18
DJ001	Intertidal	219	1135	5.18	433	1.98
DJ002	Intertidal	359	2870	7.99	2293	6.39
DJ003	Intertidal	231	2650	11.47	1727	7.48
DJ004	Intertidal	516	1480	2.87	389	0.75
DJ007	Intertidal	22	40	1.82	10	0.45
DJ010	Intertidal	15	45	3.00	16	1.05
DJ011	Intertidal	5	220	44.00	58	11.50
DJ012	Intertidal	16	530	33.13	274	17.14
DJ013	Intertidal	56	710	12.68	445	7.94
DJ015	Intertidal	85	320	3.76	120	1.41
DJ021	Intertidal	150	138	0.92	108	0.72
DJ022	Intertidal	340	2788	8.20	1212	3.56
DJ023	Intertidal	115	400	3.48	258	2.24

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DJ024	Intertidal	328	310	0.95	205	0.63
DJ025	Intertidal	826	1210	1.46	697	0.84

Table 5.2.2 Peak and mean densities (birds per hectare) of feeding Knot one hour before low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB006	Intertidal	238	150	0.63	38	0.16
DB009	Intertidal	823	450	0.55	263	0.32
DB029	Intertidal	344	222	0.65	58	0.17
DJ001	Intertidal	219	2	0.01	1	0.00
DJ002	Intertidal	359	51	0.14	24	0.07
DJ003	Intertidal	231	1851	8.01	1074	4.65
DJ004	Intertidal	516	114	0.22	32	0.06
DJ007	Intertidal	22	600	27.27	155	7.05
DJ009	Intertidal	5	9	1.80	2	0.45
DJ010	Intertidal	15	14	0.93	6	0.40
DJ011	Intertidal	5	17	3.40	4	0.85
DJ013	Intertidal	56	12	0.21	3	0.05

5.3 Feeding Birds One Hour After Low Tide

Table 5.3.1 Peak and mean densities (birds per hectare) of feeding Oystercatchers one hour after low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB003	Intertidal	102	29	0.28	15	0.14
DB004	Intertidal	316	37	0.12	23	0.07
DB006	Intertidal	238	3000	12.61	1275	5.36
DB009	Intertidal	823	1100	1.34	371	0.45
DB013	Intertidal	47	56	1.19	29	0.62
DB019	Intertidal	168	50	0.30	27	0.16
DB020	Intertidal	117	170	1.45	43	0.36
DB021	Intertidal	0	470	(14.24)	118	(3.56)
DB027	Intertidal	25	2	0.08	1	0.02
DB028	Intertidal	207	26	0.13	7	0.03
DB029	Intertidal	344	1478	4.30	1256	3.65
DB030	Intertidal	313	10	0.03	6	0.02
DB031	Intertidal	251	201	0.80	83	0.33
DB032	Intertidal	42	17	0.40	5	0.11
DB033	Intertidal	21	44	2.10	18	0.87
DJ001	Intertidal	219	1710	7.81	695	3.17
DJ002	Intertidal	359	4280	11.92	2841	7.91
DJ003	Intertidal	231	2000	8.66	1045	4.52
DJ004	Intertidal	516	1085	2.10	325	0.63
DJ007	Intertidal	22	35	1.59	9	0.40
DJ009	Intertidal	5	2	0.40	1	0.10
DJ010	Intertidal	15	35	2.33	15	1.00
DJ011	Intertidal	5	180	36.00	49	9.85
DJ012	Intertidal	16	480	30.00	254	15.84
DJ013	Intertidal	56	830	14.82	463	8.26
DJ015	Intertidal	85	130	1.53	72	0.85
DJ021	Intertidal	150	146	0.97	100	0.67
DJ022	Intertidal	340	2207	6.49	1143	3.36
DJ023	Intertidal	115	241	2.10	108	0.93
DJ024	Intertidal	328	65	0.20	62	0.19
DJ025	Intertidal	826	1141	1.38	677	0.82

Table 5.3.2 Peak and mean densities (birds per hectare) of feeding Knot one hour after low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB009	Intertidal	823	430	0.52	108	0.13
DB029	Intertidal	344	305	0.89	132	0.38
DJ001	Intertidal	219	8	0.04	2	0.01
DJ002	Intertidal	359	36	0.10	17	0.05
DJ003	Intertidal	231	714	3.09	307	1.33
DJ004	Intertidal	516	70	0.14	19	0.04
DJ007	Intertidal	22	1200	54.55	399	18.13
DJ008	Intertidal	2	450	225.00	113	56.25
DJ009	Intertidal	5	4	0.80	1	0.20
DJ010	Intertidal	15	20	1.33	5	0.33
DJ011	Intertidal	5	7	1.40	2	0.35
DJ012	Intertidal	16	3	0.19	1	0.05
DJ013	Intertidal	56	12	0.21	3	0.05
DJ015	Intertidal	85	12	0.14	3	0.04

5.4 Feeding Birds Two Hours After Low Tide

Table 5.4.1 Peak and mean densities (birds per hectare) of feeding Oystercatchers two hours after low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB003	Intertidal	102	24	0.24	11	0.11
DB004	Intertidal	316	35	0.11	10	0.03
DB006	Intertidal	238	2000	8.40	1313	5.51
DB009	Intertidal	823	1700	2.07	988	1.20
DB012	Intertidal	55	6	0.11	2	0.04
DB013	Intertidal	47	380	8.09	183	3.90
DB019	Intertidal	168	200	1.19	65	0.39
DB027	Intertidal	25	26	1.04	7	0.26
DB028	Intertidal	207	4	0.02	1	0.00
DB029	Intertidal	344	2221	6.46	1786	5.19
DB030	Intertidal	313	54	0.17	26	0.08
DB031	Intertidal	251	200	0.80	115	0.46
DB032	Intertidal	42	57	1.36	14	0.34
DB033	Intertidal	21	58	2.76	25	1.17
DJ001	Intertidal	219	842	3.84	531	2.42
DJ002	Intertidal	359	3730	10.39	2463	6.86
DJ003	Intertidal	231	1140	4.94	959	4.15
DJ004	Intertidal	516	680	1.32	237	0.46
DJ007	Intertidal	22	28	1.27	9	0.42
DJ010	Intertidal	15	25	1.67	12	0.80
DJ011	Intertidal	5	110	22.00	52	10.40
DJ012	Intertidal	16	380	23.75	229	14.29
DJ013	Intertidal	56	500	8.93	248	4.43
DJ015	Intertidal	85	95	1.11	41	0.48
DJ021	Intertidal	150	78	0.52	46	0.31
DJ022	Intertidal	340	402	1.18	376	1.10
DJ023	Intertidal	115	401	3.49	199	1.73
DJ024	Intertidal	328	170	0.52	81	0.25
DJ025	Intertidal	826	328	0.40	299	0.36

Table 5.4.2 Peak and mean densities (birds per hectare) of feeding Knot two hours after low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB006	Intertidal	238	650	2.73	243	1.02
DB009	Intertidal	823	420	0.51	185	0.22
DB029	Intertidal	344	470	1.37	189	0.55
DJ001	Intertidal	219	8	0.04	3	0.01
DJ002	Intertidal	359	33	0.09	18	0.05
DJ003	Intertidal	231	66	0.29	22	0.10
DJ004	Intertidal	516	14	0.03	4	0.01
DJ007	Intertidal	22	1200	54.55	530	24.09
DJ008	Intertidal	2	250	125.00	63	31.25
DJ010	Intertidal	15	20	1.33	7	0.44
DJ011	Intertidal	5	14	2.80	5	0.93
DJ012	Intertidal	16	17	1.06	6	0.35
DJ015	Intertidal	85	4	0.05	1	0.01

5.5 Roosting Birds Two Hours Before Low Tide

Table 5.5.1 Peak and mean densities (birds per hectare) of roosting Oystercatchers two hours before low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB003	Intertidal	102	1	0.01	0	0.00
DB004	Intertidal	316	1395	4.41	648	2.05
DB006	Intertidal	238	1500	6.30	452	1.90
DB009	Intertidal	823	2300	2.79	581	0.71
DB012	Intertidal	55	1700	30.91	583	10.61
DB013	Intertidal	47	235	5.00	124	2.64
DB018	Intertidal	286	1050	3.67	263	0.92
DB019	Intertidal	168	1050	6.25	416	2.47
DB020	Intertidal	117	470	4.02	182	1.56
DB021	Intertidal	0	278	(8.42)	103	(3.13)
DB027	Intertidal	25	100	4.00	35	1.40
DB028	Intertidal	207	108	0.52	27	0.13
DB029	Intertidal	344	327	0.95	224	0.65
DB030	Intertidal	313	595	1.90	308	0.98
DB031	Intertidal	251	1430	5.70	376	1.50
DB032	Intertidal	42	335	7.98	102	2.42
DB033	Intertidal	21	2200	104.76	597	28.43
DJ011	Intertidal	5	40	8.00	10	2.00
DJ021	Intertidal	150	51	0.34	14	0.09
DJ022	Intertidal	340	248	0.73	176	0.52
DJ023	Intertidal	115	330	2.87	126	1.10
DJ024	Intertidal	328	1870	5.70	1210	3.69

Table 5.5.2 Peak and mean densities (birds per hectare) of roosting Knot two hours before low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB006	Intertidal	238	350	1.47	88	0.37
DB009	Intertidal	823	200	0.24	50	0.06
DB013	Intertidal	47	400	8.51	100	2.13
DB019	Intertidal	168	250	1.49	63	0.37
DB032	Intertidal	42	22	0.52	6	0.13
DB033	Intertidal	21	12	0.57	3	0.14
DJ003	Intertidal	231	40	0.17	10	0.04
DJ007	Intertidal	22	1000	45.45	250	11.36
DJ012	Intertidal	16	22	1.38	6	0.34
DJ021	Intertidal	150	17	0.11	4	0.03

5.6 Roosting Birds One Hour Before Low Tide

Table 5.6.1 Peak and mean densities (birds per hectare) of roosting Oystercatchers one hour before low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB004	Intertidal	316	2240	7.09	738	2.34
DB006	Intertidal	238	2400	10.08	1064	4.47
DB009	Intertidal	823	2300	2.79	913	1.11
DB012	Intertidal	55	1700	30.91	583	10.61
DB013	Intertidal	47	320	6.81	182	3.86
DB018	Intertidal	286	1150	4.02	288	1.01
DB019	Intertidal	168	1150	6.85	426	2.54
DB020	Intertidal	117	1100	9.40	550	4.70
DB021	Intertidal	0	700	(21.21)	265	(8.03)
DB027	Intertidal	25	865	34.60	216	8.65
DB029	Intertidal	344	1642	4.77	798	2.32
DB030	Intertidal	313	470	1.50	220	0.70
DB031	Intertidal	251	2550	10.16	800	3.19
DB032	Intertidal	42	317	7.55	127	3.02
DB033	Intertidal	21	830	39.52	248	11.81
DJ002	Intertidal	359	250	0.70	83	0.23
DJ003	Intertidal	231	120	0.52	30	0.13
DJ004	Intertidal	516	155	0.30	39	0.08
DJ011	Intertidal	5	180	36.00	45	9.00
DJ021	Intertidal	150	88	0.59	28	0.18
DJ022	Intertidal	340	503	1.48	302	0.89
DJ023	Intertidal	115	90	0.78	56	0.49
DJ024	Intertidal	328	2010	6.13	1305	3.98

Table 5.6.2 Peak and mean densities (birds per hectare) of roosting Knot one hour before low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB006	Intertidal	238	1300	5.46	653	2.74
DB009	Intertidal	823	150	0.18	38	0.05
DJ003	Intertidal	231	20	0.09	5	0.02
DJ012	Intertidal	16	35	2.19	9	0.55
DJ021	Intertidal	150	52	0.35	13	0.09

5.7 Roosting Birds One Hour After Low Tide

Table 5.7.1 Peak and mean densities (birds per hectare) of roosting Oystercatchers one hour after low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB003	Intertidal	102	17	0.17	6	0.06
DB004	Intertidal	316	279	0.88	93	0.30
DB006	Intertidal	238	3400	14.29	1451	6.10
DB009	Intertidal	823	2600	3.16	1250	1.52
DB012	Intertidal	55	1500	27.27	512	9.30
DB013	Intertidal	47	405	8.62	278	5.92
DB018	Intertidal	286	1375	4.81	459	1.60
DB019	Intertidal	168	1675	9.97	526	3.13
DB020	Intertidal	117	900	7.69	445	3.80
DB021	Intertidal	0	1200	(36.36)	300	(9.09)
DB027	Intertidal	25	960	38.40	357	14.26
DB028	Intertidal	207	232	1.12	59	0.28
DB029	Intertidal	344	984	2.86	596	1.73
DB030	Intertidal	313	430	1.37	267	0.85
DB031	Intertidal	251	1900	7.57	488	1.94
DB032	Intertidal	42	730	17.38	247	5.88
DB033	Intertidal	21	800	38.10	337	16.03
DJ003	Intertidal	231	264	1.14	66	0.29
DJ021	Intertidal	150	58	0.39	34	0.23
DJ022	Intertidal	340	715	2.10	396	1.16

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DJ023	Intertidal	115	420	3.65	218	1.90
DJ024	Intertidal	328	2000	6.10	1383	4.22

Table 5.7.2 Peak and mean densities (birds per hectare) of roosting Knot one hour after low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB006	Intertidal	238	1500	6.30	630	2.65
DB009	Intertidal	823	350	0.43	165	0.20
DJ003	Intertidal	231	1230	5.32	313	1.35
DJ012	Intertidal	16	52	3.25	13	0.81

5.8 Roosting Birds Two Hours After Low Tide

Table 5.8.1 Peak and mean densities (birds per hectare) of roosting Oystercatchers two hours after low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB003	Intertidal	102	42	0.41	16	0.16
DB004	Intertidal	316	1410	4.46	417	1.32
DB006	Intertidal	238	2450	10.29	1026	4.31
DB009	Intertidal	823	3500	4.25	1066	1.29
DB012	Intertidal	55	1100	20	372	6.76
DB013	Intertidal	47	425	9.04	284	6.05
DB018	Intertidal	286	1300	4.55	325	1.14
DB019	Intertidal	168	1400	8.33	516	3.07
DB020	Intertidal	117	2600	22.22	1373	11.74
DB021	Intertidal	0	1000	(30.30)	500	(15.15)
DB027	Intertidal	25	1270	50.80	343	13.70
DB029	Intertidal	344	247	0.72	198	0.57
DB030	Intertidal	313	410	1.31	250	0.80
DB031	Intertidal	251	2800	11.16	703	2.80
DB032	Intertidal	42	260	6.19	73	1.74
DB033	Intertidal	21	340	16.19	126	6.00
DJ002	Intertidal	359	50	0.14	17	0.05
DJ003	Intertidal	231	36	0.16	12	0.05
DJ021	Intertidal	150	110	0.73	64	0.42
DJ022	Intertidal	340	1328	3.91	797	2.34
DJ023	Intertidal	115	490	4.26	236	2.05
DJ024	Intertidal	328	2055	6.27	1498	4.57

Table 5.8.2 Peak and mean densities (birds per hectare) of roosting Knot two hours after low tide on count sections on which it was present.

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB006	Intertidal	238	500	2.10	235	0.99
DB009	Intertidal	823	230	0.28	58	0.07
DB013	Intertidal	47	1	0.02	0	0.01
DJ003	Intertidal	231	1438	6.23	479	2.08
DJ009	Intertidal	5	17	3.40	4	0.85

5.9 Feeding Birds (Mean Across Tidal Cycle)

Table 5.9.1 Peak and mean densities (birds per hectare) of feeding Oystercatchers on count sections on which it was present (mean across tidal cycle).

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB001	Intertidal	21	1	0.05	0	0.01
DB003	Intertidal	102	33	0.32	21	0.21
DB004	Intertidal	316	681	2.15	527	1.67
DB005	Intertidal	82	14	0.17	5	0.06
DB006	Intertidal	238	2688	11.29	1425	5.99
DB009	Intertidal	823	1303	1.58	762	0.93
DB011	Intertidal	25	1	0.02	1	0.02
DB012	Intertidal	55	2	0.03	0	0.01
DB013	Intertidal	47	194	4.13	111	2.36
DB018	Intertidal	286	29	0.1	8	0.03
DB019	Intertidal	168	91	0.54	36	0.21
DB020	Intertidal	117	160	1.37	43	0.37
DB021	Intertidal	0	284	-8.61	85	-2.57
DB027	Intertidal	25	15	0.59	7	0.28
DB028	Intertidal	207	11	0.05	3	0.01
DB029	Intertidal	344	1710	4.97	1437	4.18
DB030	Intertidal	313	153	0.49	43	0.14
DB031	Intertidal	251	128	0.51	75	0.3
DB032	Intertidal	42	140	3.32	57	1.36
DB033	Intertidal	21	49	2.32	34	1.63
DB034	Intertidal	635	18	0.03	18	0.03
DJ001	Intertidal	219	1423	6.5	569	2.6
DJ002	Intertidal	359	3980	11.09	2636	7.34
DJ003	Intertidal	231	1698	7.35	1248	5.4
DJ004	Intertidal	516	1179	2.28	339	0.66
DJ007	Intertidal	22	37	1.68	9	0.42
DJ009	Intertidal	5	1	0.1	0	0.03
DJ010	Intertidal	15	36	2.42	14	0.95
DJ011	Intertidal	5	198	39.5	59	11.75
DJ012	Intertidal	16	474	29.61	253	15.84
DJ013	Intertidal	56	737	13.17	437	7.81

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DJ015	Intertidal	85	307	3.61	120	1.41
DJ021	Intertidal	150	123	0.82	95	0.63
DJ022	Intertidal	340	2402	7.06	1103	3.24
DJ023	Intertidal	115	264	2.29	169	1.47
DJ024	Intertidal	328	217	0.66	161	0.49
DJ025	Intertidal	826	1134	1.37	643	0.78

Table 5.9.2 Peak and mean densities (birds per hectare) of feeding Knot on count sections on which it was present (mean across tidal cycle).

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB004	Intertidal	316	1	0	0	0
DB006	Intertidal	238	358	1.5	214	0.9
DB009	Intertidal	823	455	0.55	291	0.35
DB019	Intertidal	168	25	0.15	6	0.04
DB029	Intertidal	344	416	1.21	163	0.47
DB031	Intertidal	251	63	0.25	16	0.06
DJ001	Intertidal	219	5	0.02	1	0.01
DJ002	Intertidal	359	707	1.97	191	0.53
DJ003	Intertidal	231	1074	4.65	721	3.12
DJ004	Intertidal	516	53	0.1	19	0.04
DJ007	Intertidal	22	600	27.27	275	12.51
DJ008	Intertidal	2	294	146.88	73	36.72
DJ009	Intertidal	5	3	0.65	1	0.16
DJ010	Intertidal	15	17	1.13	5	0.33
DJ011	Intertidal	5	10	2.05	3	0.58
DJ012	Intertidal	16	8	0.48	2	0.12
DJ013	Intertidal	56	10	0.18	3	0.05
DJ015	Intertidal	85	5	0.06	1	0.02

5.10 Roosting Birds (Mean Across Tidal Cycle)

Table 5.10.1 Peak and mean densities (birds per hectare) of roosting Oystercatchers on count sections on which it was present (mean across tidal cycle).

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB003	Intertidal	102	11	0.11	6	0.06
DB004	Intertidal	316	1261	3.99	474	1.5
DB006	Intertidal	238	2071	8.7	998	4.19
DB009	Intertidal	823	1925	2.34	952	1.16
DB012	Intertidal	55	1500	27.27	384	6.99
DB013	Intertidal	47	308	6.55	217	4.62
DB018	Intertidal	286	1219	4.26	305	1.07
DB019	Intertidal	168	1319	7.85	403	2.4
DB020	Intertidal	117	1125	9.62	572	4.89
DB021	Intertidal	0	710	-21.5	247	-7.48
DB027	Intertidal	25	799	31.95	238	9.5
DB028	Intertidal	207	85	0.41	21	0.1
DB029	Intertidal	344	631	1.83	454	1.32
DB030	Intertidal	313	453	1.45	255	0.81
DB031	Intertidal	251	1113	4.43	327	1.3
DB032	Intertidal	42	293	6.96	137	3.26
DB033	Intertidal	21	1043	49.64	306	14.57
DJ002	Intertidal	359	125	0.35	35	0.1
DJ003	Intertidal	231	128	0.55	34	0.15
DJ004	Intertidal	516	39	0.08	10	0.02
DJ011	Intertidal	5	73	14.67	18	3.67
DJ021	Intertidal	150	67	0.44	31	0.21
DJ022	Intertidal	340	693	2.04	376	1.11
DJ023	Intertidal	115	333	2.89	159	1.38
DJ024	Intertidal	328	1984	6.05	1349	4.11

Table 5.10.2 Peak and mean densities (birds per hectare) of roosting Knot on count sections on which it was present (mean across tidal cycle).

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB006	Intertidal	238	913	3.83	401	1.69
DB009	Intertidal	823	175	0.21	78	0.09
DB013	Intertidal	47	100	2.13	25	0.53
DB019	Intertidal	168	63	0.37	16	0.09
DB032	Intertidal	42	6	0.13	1	0.03
DB033	Intertidal	21	3	0.14	1	0.04
DJ003	Intertidal	231	430	1.86	199	0.86
DJ007	Intertidal	22	250	11.36	63	2.84
DJ009	Intertidal	5	4	0.85	1	0.21
DJ012	Intertidal	16	27	1.7	7	0.43
DJ021	Intertidal	150	17	0.12	4	0.03

5.11 Feeding Birds (Maximum Across Tidal Cycle)

Table 5.11.1 Peak and mean densities (birds per hectare) of feeding Oystercatchers on count sections on which it was present (maximum across tidal cycle).

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB001	Intertidal	21	1	0.05	0	0.01
DB003	Intertidal	102	56	0.55	35	0.34
DB004	Intertidal	316	2237	7.08	1841	5.82
DB005	Intertidal	82	55	0.67	21	0.25
DB006	Intertidal	238	3300	13.87	2275	9.56
DB009	Intertidal	823	1800	2.19	1413	1.72
DB011	Intertidal	25	1	0.04	1	0.04
DB012	Intertidal	55	6	0.11	2	0.04
DB013	Intertidal	47	380	8.09	268	5.71
DB018	Intertidal	286	115	0.40	30	0.10
DB019	Intertidal	168	200	1.19	82	0.49
DB020	Intertidal	117	370	3.16	103	0.88
DB021	Intertidal	0	470	(14.24)	160	(4.86)
DB027	Intertidal	25	32	1.28	20	0.80
DB028	Intertidal	207	26	0.13	7	0.03
DB029	Intertidal	344	2221	6.46	1925	5.60
DB030	Intertidal	313	377	1.20	105	0.33
DB031	Intertidal	251	210	0.84	136	0.54
DB032	Intertidal	42	537	12.79	224	5.32
DB033	Intertidal	21	123	5.86	76	3.61
DB034	Intertidal	635	70	0.11	70	0.11
DJ001	Intertidal	219	1710	7.81	826	3.77
DJ002	Intertidal	359	4280	11.92	3135	8.73
DJ003	Intertidal	231	2650	11.47	1987	8.60
DJ004	Intertidal	516	1480	2.87	573	1.11
DJ007	Intertidal	22	45	2.05	11	0.51
DJ009	Intertidal	5	2	0.40	1	0.10
DJ010	Intertidal	15	45	3.00	19	1.28
DJ011	Intertidal	5	280	56.00	88	17.65
DJ012	Intertidal	16	530	33.13	298	18.63
DJ013	Intertidal	56	830	14.82	511	9.12

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DJ015	Intertidal	85	472	5.55	185	2.18
DJ021	Intertidal	150	146	0.97	123	0.82
DJ022	Intertidal	340	2788	8.20	1402	4.12
DJ023	Intertidal	115	401	3.49	314	2.73
DJ024	Intertidal	328	325	0.99	296	0.90
DJ025	Intertidal	826	1210	1.46	717	0.87

Table 5.11.2 Peak and mean densities (birds per hectare) of feeding Knot on count sections on which it was present (maximum across tidal cycle).

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB004	Intertidal	316	2	0.01	1	0.00
DB006	Intertidal	238	1130	4.75	613	2.57
DB009	Intertidal	823	1500	1.82	638	0.77
DB019	Intertidal	168	100	0.60	25	0.15
DB029	Intertidal	344	879	2.56	292	0.85
DB031	Intertidal	251	250	1.00	63	0.25
DJ001	Intertidal	219	8	0.04	2	0.01
DJ002	Intertidal	359	2120	5.91	551	1.53
DJ003	Intertidal	231	1875	8.12	1343	5.81
DJ004	Intertidal	516	114	0.22	47	0.09
DJ007	Intertidal	22	1200	54.55	456	20.73
DJ008	Intertidal	2	475	237.50	119	59.38
DJ009	Intertidal	5	9	1.80	2	0.45
DJ010	Intertidal	15	20	1.33	8	0.50
DJ011	Intertidal	5	17	3.40	6	1.10
DJ012	Intertidal	16	17	1.06	4	0.27
DJ013	Intertidal	56	17	0.30	4	0.08
DJ015	Intertidal	85	12	0.14	3	0.04

5.12 Roosting Birds (Maximum Across Tidal Cycle)

Table 5.12.1 Peak and mean densities (birds per hectare) of roosting Oystercatchers on count sections on which it was present (maximum across tidal cycle).

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB003	Intertidal	102	42	0.41	18	0.17
DB004	Intertidal	316	2240	7.09	966	3.06
DB006	Intertidal	238	3400	14.29	1664	6.99
DB009	Intertidal	823	3500	4.25	1803	2.19
DB012	Intertidal	55	1700	30.91	438	7.95
DB013	Intertidal	47	425	9.04	338	7.19
DB018	Intertidal	286	1375	4.81	344	1.20
DB019	Intertidal	168	1675	9.97	593	3.53
DB020	Intertidal	117	2600	22.22	1155	9.87
DB021	Intertidal	0	1200	(36.36)	500	(15.14)
DB027	Intertidal	25	1270	50.80	450	18.00
DB028	Intertidal	207	232	1.12	59	0.28
DB029	Intertidal	344	1642	4.77	945	2.75
DB030	Intertidal	313	602	1.92	393	1.26
DB031	Intertidal	251	2800	11.16	871	3.47
DB032	Intertidal	42	730	17.38	284	6.77
DB033	Intertidal	21	2200	104.76	619	29.46
DJ002	Intertidal	359	250	0.70	75	0.21
DJ003	Intertidal	231	264	1.14	75	0.32
DJ004	Intertidal	516	155	0.30	39	0.08
DJ011	Intertidal	5	180	36.00	45	9.00
DJ021	Intertidal	150	110	0.73	61	0.41
DJ022	Intertidal	340	1328	3.91	778	2.29
DJ023	Intertidal	115	490	4.26	244	2.12
DJ024	Intertidal	328	2055	6.27	1498	4.57

Table 5.12.2 Peak and mean densities (birds per hectare) of roosting Knot on count sections on which it was present (maximum across tidal cycle).

Sector code	Preferred habitat	Area of preferred habitat	Peak count	Peak density	Mean count	Mean density
DB006	Intertidal	238	1500	6.30	723	3.04
DB009	Intertidal	823	350	0.43	203	0.25
DB013	Intertidal	47	400	8.51	100	2.13
DB019	Intertidal	168	250	1.49	63	0.37
DB032	Intertidal	42	22	0.52	6	0.13
DB033	Intertidal	21	12	0.57	3	0.14
DJ003	Intertidal	231	1438	6.23	673	2.91
DJ007	Intertidal	22	1000	45.45	250	11.36
DJ009	Intertidal	5	17	3.40	4	0.85
DJ012	Intertidal	16	52	3.25	13	0.81
DJ021	Intertidal	150	52	0.35	13	0.09