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ALL WALES COMMON SCOTER SURVEY: REPORT ON 2002/03 WORK PROGRAMME

WWT Wetlands Advisory Service

Authors
Peter Cranswick, Colette Hall & Lucy Smith

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Cafodd Arolwg Cymru gyfan o'r Fôr Hwyaden Ddu (ACGMDd) ei sefydlu i asesu niferoedd a dosbarthiad y Fôr Hwyaden Ddu yn Mae Caerfyrddin, Bae Ceredigion a Bae Lerpwl (o Ynys Môn hyd at Fae Morcambe). Byddai’r data yma yn cael eu defnyddio i asesu cynhwysydd posibil sa料eodd o’r Ardaloedd Gwarchodaeth Arbenig (AGA), i ni gwybodaeth i’r astudiaeth achos (yn enwedig mewn perthynas â datblygiadau fferm ym yr o’r tir) ac i ddatblygu ddiwallu croeso i effeithiol i gynorthwyo gyda thargedau Cynllun Gweithredu Bioamrywiaeth a chydra strategaeth ffonitro’r hwyaden fôr yn genedlaethol.

Cafodd techneg arolwg o’r awyr ei chyflwyno yn 2001/02, gan ddilyn dull gafodd ei ddatblygu yn ddiweddar yn Nenmarc yn cynnwys y defnydd o System Global Positioning sy’n ei gwneud yn bosibl cofnodi lleoliadau adar yn gywir iawn. Yn yr awr o’r awyr hefyd defnyddiwed samplu ‘distance’ lle na chaiff pob aderyn ei weld ond, gan ddefnyddiwr o’r pellter o ble y cafodd yr adar eu gweld, mae’n bosibl cyfrifo rhif cywir yr adar sydd yn bresennol.

Cafodd arolwg o’r awyr ei wneud yn 2002/03 (yn Awst, Tachwedd, Rhagfyr, Ionawr, Chwefror a Mai). Gwnaethaith ym Mae Caerfyrddin, Bae Ceredigion, Bae Lerpwl yn ystod pob un o’r misoedd uchodd (er na chaiff rhannau o’r gornel dde-ddwyreiniol mo’i harolygu yn ystod o’r misoedd yma ) a Bae Ceredigion yn ystod pob mis mis heblaw Ionawr a Mai. Roedd a wnelo’r arolygon â’r dyfroedd ger y lan ac â’r dyfroedd bas ac roedd yn ymestyn, yn y rhan fwyaf o’r ardaloedd, hyd at oddoedd 25 cilomedr o’r lan.

Roedd y cyfansymaniau gyfrifwyd o’r Fôr Hwyaden Ddu yn llawer uchaf nag yn 2001/02, yn fwy na 12,000 o adar ym Mae Lerpwl yn ystod tri o bedwar mis y gaaef, ac yn fwy na 24,000 yn Chweffor 2003; roedd y niferoedd dros Shell Flat unig yn 14,000 yn ystod yr un mis, y cyfanswm uchaf uchaf yma a gofnodwyd yn dilyn aralw dros o’r awyr o’r Fôr Hwyaden Ddu ar un safle ym y D U. Roedd y niferoedd a gyfrifwyd o’r Fôr Hwyaden Ddu ym Mae Lerpwl yn yr un misoedd dros o’r niferoedd tebyg y mae’n debyg mewn ymateb i newidiadau eu rhywogaeth.

Roedd y niferoedd y trochyddion – ni chaiff pob un ohonynt ei nodi yn ôl lôl hwylwaeth, ond y rhan fwyaf ohonynt mae’n debyg ym Mae Lerpwl a Ceredigion yn ymestyn mewn debyg uchaf hefyd wedi’u cyfrifo. Doedd o’r niferoedd y trochyddion erioed y mae’n debyg i’w nodi mewn un o’r gornel dde-ddwyreiniol, ond y rhan fwyaf ohonynt mae’n debyg i’w nodi mewn ystod fechplyw ym Mae Lerpwl a Ceredigion. Roedd niferoedd tebyg eu wneud ym Mae Lerpwl i gyflogi o fewn rhai o’r niferoedd tebyg a gyfrifwyd ym Mae Lerpwl a Ceredigion.

Roedd nifer helaeth o wylanod a carfilod eu wneud yn ystod 2002/03: roedd gwylanod wedi’u ddefnyddio o fewn rhai o’r gornel dde-ddwyreiniol, ond y rhan fwyaf ohonynt mae’n debyg i’w nodi mewn ystod fechplyw ym Mae Lerpwl a Ceredigion. Roedd nifer helaeth o trochyddion – ni chaiff pob un ohonynt ei nodi yn ôl lôl hwylwaeth, ond y rhan fwyaf ohonynt mae’n debyg y trochyddion y mae’n debyg mewn un o’r gornel dde-ddwyreiniol, ond y rhan fwyaf ohonynt mae’n debyg i’w nodi mewn ystod fechplyw ym Mae Lerpwl a Ceredigion. Roedd nifer helaeth o trochyddion – ni chaiff pob un ohonynt ei nodi yn ôl lôl hwylwaeth, ond y rhan fwyaf ohonynt mae’n debyg y trochyddion y mae’n debyg mewn un o’r gornel dde-ddwyreiniol, ond y rhan fwyaf ohonynt mae’n debyg i’w nodi mewn ystod fechplyw ym Mae Lerpwl a Ceredigion.

Roedd nifer helaeth o trochyddion – ni chaiff pob un ohonynt ei nodi yn ôl lôl hwylwaeth, ond y rhan fwyaf ohonynt mae’n debyg y trochyddion y mae’n debyg mewn un o’r gornel dde-ddwyreiniol, ond y rhan fwyaf ohonynt mae’n debyg i’w nodi mewn ystod fechplyw ym Mae Lerpwl a Ceredigion. Roedd nifer helaeth o trochyddion – ni chaiff pob un ohonynt ei nodi yn ôl lôl hwylwaeth, ond y rhan fwyaf ohonynt mae’n debyg y trochyddion y mae’n debyg mewn un o’r gornel dde-ddwyreiniol, ond y rhan fwyaf ohonynt mae’n debyg i’w nodi mewn ystod fechplyw ym Mae Lerpwl a Ceredigion.
Dylid ystyried ehangu ardal yr arolwg i'r gorllewin ar hyd arfordirogleddol Ynys Môn a dylid ystyried gwneud arolygon mwy rheolaidd yn rhannau gogleddol ardal yr arolwg i helpu gyda lleoli ffin yr AGA. Dylid cynnal arolygon ymchwiliol yn gynnar ac yn hwyr yn y dydd yn y prif leoedd ymgynnull er mwyn asesu a oes gwaahaniaethau yn y dosbarthiad ar yr adegau hynny.
SUMMARY

The All Wales Common Scoter Survey (AWCSS) was established to assess the numbers and distribution of Common Scoter in Carmarthen Bay, Cardigan Bay and Liverpool Bay (from Anglesey to Morecambe Bay). These data would be used to assess possible qualification of sites as Special Protection Areas (SPAs), inform casework (particularly in relation to offshore wind farm developments) and develop cost-effective monitoring methods to assist with Biodiversity Action Plan targets and a national seaduck monitoring strategy.

An aerial survey technique was introduced in 2001/02, following a method recently developed in Denmark, incorporating the use of a Global Positioning System (which enables the locations of birds to be recorded with a high degree of accuracy), and using ‘distance’ sampling (whereby not all birds are detected but, using the distance from the plane of observed birds, the true number of birds present can be calculated).

Aerial survey was undertaken in 2002/03 (in August, November, December, January, February and May). Liverpool Bay was surveyed in all months (although parts of the southeastern corner were not covered in some) and Cardigan Bay in all months except January and May. Surveys covered nearshore and shallow waters and extended, in most areas, to around 25 km from shore. Carmarthen Bay was only surveyed in August.

Counted totals of Common Scoter were markedly higher than in 2001/02, exceeding 12,000 birds in Liverpool Bay in three of the four winter months, and exceeding 24,000 in February 2003; numbers over Shell Flat alone were 14,000 in the same month, the highest recorded aerial survey total of Common Scoter at a single UK site to date. Counted numbers in Cardigan Bay varied between 2000 and 4000. Estimates of the true number present (calculated using ‘distance analysis’ as part of a separate exercise) suggest that at least 25,000 birds were present in Liverpool Bay during winter months in 2002/03, and over 79,000 in February 2003. Numbers in Liverpool Bay as a whole, and perhaps within some of its constituent sites, therefore exceeded the 1% international threshold (16,000) and, following similar numbers in the previous two winters, the site qualifies for designation as a marine Special Protection Area (SPA). No estimates were made of true numbers in Cardigan Bay.

Sites favoured by Common Scoter in Liverpool and Cardigan Bays closely matched those identified in 2001/02. There was an apparent shift of birds to deeper waters as winter progressed, presumed to be in response to food depletion. A survey in August 2002 recorded over 6000 birds, a time of year when wildfowl moult their wing feathers and are flightless for a period of 4-6 weeks; circumstantial evidence supports the suggestion that a proportion was likely to have been flightless. Very few birds remained by mid May, suggesting (based on observations in spring 2002) that the main departure from Liverpool Bay occurs in late April or early May.

Numbers of divers – which were not all identified to species, but most of which are likely to have been Red-throated Divers – were widely distributed throughout Liverpool and Cardigan Bays. Birds were present between November and February, and their distribution extended further offshore than scoters. Counted numbers were relatively small, but exceeded the 1% national threshold in Liverpool Bay in three months. Estimates using ‘distance analysis’ suggest that between 250 and 1200 birds were present during winter months in 2002/03. Similar numbers were recorded in 2001/02 and, following UK Government guidelines that sites supporting this number of species listed on Annex 1 of the EC Birds Directive qualify as an SPA, Liverpool Bay also qualifies for designation as a marine SPA based on numbers of divers.

Large numbers of gulls and auks were recorded in many months during survey in 2002/03: gulls were thinly but widely distributed throughout the survey area, while the distribution of auks varied between months, presumed to be in response to changes in the distribution of their prey.

Further aerial survey is recommended using the same technique to improve understanding of changes in numbers and distribution during the winter, late summer and spring periods, and to assess variation between years. Surveys should be undertaken of the whole of Liverpool bay – from Anglesey to Morecambe Bay – to cover all areas important for the key species as synchronously as possible. Consideration should be given to extending the survey area west along the north coast of Anglesey and to more regular coverage in northern parts of the survey area to assist with SPA boundary placement. Exploratory surveys early and late in the day should be conducted at the key concentrations to assess whether differences in distribution exist at those times.
1 INTRODUCTION

1.1 Background

Until the early 1990s, best estimates suggested that some 35,000 Common Scoter Melanitta nigra wintered in the UK, concentrated at just a few key sites (Kirby et al. 1993). The species is listed on Annex II/2 of the EC Directive on the Conservation of Wild Birds (79/409/EEC) and the ‘red list’ of the UK’s ‘Birds of Conservation Concern’ (Gregory et al. 2002), and is a UK Biodiversity Action Plan (BAP) priority species. Actions identified within the Species Action Plan include survey and monitoring of wintering birds.

Common Scoter suffered some of the worst effects of the Sea Empress oil spill in Pembrokeshire, February 1996. In response, the Countryside Council for Wales (CCW) initiated studies of the numbers and distribution of over-wintering scoter in Carmarthen Bay and the distribution and dynamics of their prey, the marine benthic invertebrate communities. Aerial and land-based surveys conducted over a three-year period confirmed this site as the most important in the UK for Common Scoter, given the presence of approximately 20,000 birds in recent winters (L. Smith unpublished data).

In 2000/01, aerial surveys of Common Scoter in Liverpool Bay identified numbers exceeding the international 1% threshold (16,000; Wetlands International 2002) (Oliver et al. 2001). Survey was extended in February 2001 to include Cardigan Bay, a site of known importance for Common Scoter. Coverage of all three key sites at this time found unprecedented numbers in Welsh waters as a whole (WWT unpublished data) and the estimate of Common Scoter in Britain was revised to 50,000, perhaps even 65,000 (Cranswick in press).

The UK has made a commitment that 10% of electricity in the UK should be generated from renewable sources by 2010. Offshore windfarms have the potential to make a significant contribution to this target and the UK Government’s announcement of the first major round of UK offshore windfarm development in December 2000 resulted in eighteen companies pre-qualifying for site development. This included many potential developments in Liverpool Bay.

To ensure that a long-term view is taken that adheres to the principle of sustainability, contributes to UK Government targets for renewable energy, and complies with European Directives (including the forthcoming Strategic Environmental Assessment Directive (SEA)), the DTI launched a consultation paper ‘Future Offshore’. This proposed a strategic planning framework as a basis for expansion of the offshore wind industry and set out the DTI’s commitment to undertake an SEA for the second round of licences in three strategic areas: the North West, the Greater Wash, and the Thames Estuary.

Few appropriate data are available on scoter and other waterbird use of inshore waters in the UK to inform conservation and planning needs. Improved knowledge of the use of Welsh waters is particularly important with respect to emerging commercial interests in shallow waters, many of which may pose a threat to the waterbirds through loss of habitat, exclusion through disturbance or direct mortality through collision. Data are also necessary to provide a baseline for the development of sensitive management and monitoring of statutory sites and for a prompt and effective response to (and subsequent assessment of the effect of) events such as oil spills.

1.2 All Wales Common Scoter Survey

In response to the conservation interests, particularly for Common Scoter, and the need to assess the potential effects of developments in Liverpool Bay, the All Wales Common Scoter Survey (AWCSS) was established to conduct a series of all-Wales and northwest England aerial surveys throughout the winter and to better understand the use of Welsh and English near-shore waters by scoter and other waterbirds. The specific objectives of the project were to:

- Provide data to support boundary identification and baseline monitoring of Carmarthen Bay SPA;
- Collect data on the location and movements of Common Scoter within Carmarthen Bay to inform casework within the area, particularly in relation to hydraulic fisheries;
- Collect further data to determine potential SPA status of parts of Liverpool Bay;
- Collect information on location and movements of Common Scoter within Liverpool Bay to inform casework within the area, particularly in relation to offshore wind turbine developments;
• Identify any other important over-wintering areas for the species in Welsh waters (related to UK BAP targets);

• Develop cost-effective monitoring methods (related to BAP targets); and

• Contribute to seaduck monitoring strategy currently being developed by The Wildfowl & Wetlands Trust (WWT); and

• Develop a model of the species, density, age classes and distribution of marine molluscs eaten by Common Scoter.

The first year of comprehensive survey in 2001/02 (Wetlands Advisory Service 2003) confirmed the presence of large numbers of Common Scoter in Welsh waters and Liverpool Bay. Estimates of total numbers (i.e. allowing for birds inevitably missed during aerial survey) suggested numbers varied between 13,000 and 21,000 in Liverpool Bay between October 2001 and April 2002, between 5,000 and 6,300 in Cardigan Bay and between 12,000 and 18,600 in Carmarthen Bay. Land-based counts recorded a peak of 20,000 scoter in Carmarthen Bay, and (during the only count, in December 2001) around 4,000 in both Cardigan Bay and along the North Wales coast. A preliminary survey of benthos in Liverpool Bay found no obvious relationship between the distribution of Common Scoter and their mollusc prey.

This report presents results of the AWCSS work programme in 2002/03, which concentrated primarily on aerial survey in Liverpool and Cardigan Bays, undertaken by WWT’s Wetlands Advisory Service. Most work in Carmarthen Bay was undertaken in a separate project and will be reported elsewhere.
2 METHODS

2.1 Aerial survey

Aerial surveys have been used for several decades to count birds at sea, particularly in the Baltic and southern North Sea. A small plane with two observers is used, flying at low altitude: each observer counts birds on or flying just above the water’s surface to one side of the plane. Historically, surveys used either a ‘total count’ method, aiming to count all birds within a predefined area, or to cover larger areas using ‘transect counts’, whereby observers counted birds in a strip of water that extended a set distance to either side of the flight path of the plane; the total number of birds in the study area was then calculated based on the proportion of the total area represented by the surveyed strips.

Aerial surveys used for this report were undertaken using a methodology recently developed in Denmark by the National Environment Research Institute (NERI) (Kahlert et al. 2000; see also Camphuysen et al. 2004). This involved a ‘distance sampling’ approach (see Buckland et al. 2001), whereby the distance to each bird/flock of birds was recorded. Because birds further from the observer will be more difficult to detect, recording of distance allows the number of missed birds to be estimated. This approach allows statistical analyses of the data (e.g. confidence limits to be calculated for estimates of numbers) that are not possible with data collected using previous aerial survey methods. Further, using a combination of the time at which birds were encountered and the track flown by the plane (recorded using a Global Positioning System (GPS)), the locations of observed birds can be calculated with considerable accuracy (in most cases, to within a few hundred metres).

Aerial surveys were undertaken by WWT Wetlands Advisory Service using experienced observers who have undertaken aerial survey previously for the AWCSS and for many of the offshore windfarm sites in the UK in 2001/02 and 2002/03. A Partenavia PN68 aircraft was used, flying at an altitude of 250 ft and at a speed of approximately 200 kmh⁻¹. A navigator guided the pilot along transect lines with the aid of a GPS. The location of the plane, recorded using a GPS, was downloaded onto a laptop computer every five seconds.

A series of transects spaced 2 km apart was designed to cover nearshore waters. Transects were orientated perpendicular to major environmental gradients (primarily sea depth) and, where possible, to run north-south to reduce the effect of glare at the time of the survey (surveys were centred around midday).

For each bird or flock of birds, the species, number, behaviour, distance band and the time at which it was perpendicular to the flight path of the plane were recorded using a dictaphone. Using a clinometer, birds were located in one of four distance bands covering an area from 44 m to 1000 m either side of the plane; birds beyond 1000 m from the flight path of the plane were not recorded (Fig. 1). The survey method assumes that all birds in distance Band A were detected, and effort was concentrated on this band. Inevitably, birds further from the plane in other bands are missed owing to their distance from their plane and the need for the observers to concentrate observation on the area of sea nearest the flight line.

![Figure 1. Distance bands used for aerial survey (not to scale).](image-url)
Observations were not made during the turns between the end of one transect and the start of the next, though significant observations, e.g. cetaceans or large flocks of birds, were sometimes recorded on an ad hoc basis.

A cautionary approach was taken with regard to species identification, such that only those individuals that were observed clearly were identified to species level; otherwise, birds were identified as being in a species group, e.g. diver (Gavia spp.), pale-backed gull (Common L arus canus or Herring Gull L arus argentatus), dark-backed gull (Lesser Black-backed L arus fuscus or Great Black-backed Gull L arus marinus), large gull (Herring, Lesser Black-backed or Great Black-backed Gull) or gull (L arus spp. or Kittiwake Rissa tridactyla). Many divers and gulls can be identified to species, but auks are very difficult to distinguish except using binoculars.

Surveys were generally made during a four-hour period centred on midday to minimise the effects of glare on counts. Surveys were undertaken in good weather conditions, generally with winds of 15 knots or less.

2.2 Coverage

The surveyed area extended to about 20 km from shore, or several kilometres beyond the 10 m depth contour, whichever was the greater, to cover areas that could potentially be exploited by scoter and likely to hold the majority of other sea-using waterbirds (divers, grebes and ducks).

The area covered in Liverpool Bay extended from Red Wharf Bay (Anglesey) to Fleetwood (at the southern end of Morecambe Bay), and occasionally to the north end of Walney Island; in Cardigan Bay from Aberystwyth to just west of Pwllheli; and Carmarthen Bay (this last only surveyed in August). This area comprises several widely recognised sites for waterbirds and count totals presented in this report are divided into these areas (Fig. 2).

Surveys were undertaken in August 2002, during each month from November 2002 to February 2003 inclusive, and in May 2003. Not all areas were covered in each month, and the dates of survey of each of the main sites are given in Table 1 (see also Figs. 3-8 for precise extent of transects flown in each month).

Table 1. Dates of aerial survey of key areas for the All Wales Common Scoter Survey, 2002/03. Shaded boxes with no dates indicate that no coverage was undertaken; shaded boxes with a date indicate that just one or two transects within that area were surveyed.

<table>
<thead>
<tr>
<th>Site</th>
<th>Aug 02</th>
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Figure 2. Sub-sites within All Wales Common Scoter Survey area

Note: the surveyed transects did not extend to cover all sea area within each rectangle, e.g. the Dee Estuary and offshore areas of Red-Wharf and Conwy Bay were not flown (see Figs. 3-8 for precise extent of transects flown in each month).
2.3 Analysis and map production

The precise location of each bird or flock of birds was calculated by linking the time (to the nearest second) at which they were recorded and the location of the plane, recorded from the GPS (generally, every five seconds). Interpolation of the GPS data enabled each position to be located along the flight path. The locations of birds detected were displaced either side of the flight path according to side of the plane and roughly in the middle of the distance band in which they recorded. The location of most observations is considered to be accurate to within 2-300 m.

The distribution of the more numerous species (or species groups) in the strategic area is shown using encounter rate, i.e. the numbers of birds counted per unit length of transect flown. Data are summarised by 2 x 2 km grid squares, corrected for survey effort (distance flown over which observers were actively looking for birds) in each cell. Casual observations of ‘out of transect birds’ (e.g. those recorded while the plane was turning between transects) were omitted from this analysis.

The density scales used in the maps were selected to illustrate the distribution patterns of encounter rates. They are broadly consistent between surveys but are not comparable between species due to the different detectability of different species. Note that the range of relative density values may vary markedly between species and between months, and reference should be made to the key in each figure to interpret apparent high concentrations of birds appropriately.

2.4 Analytical methods for population assessment

The total numbers of birds present were calculated as part of a separate exercise (Webb et al. 2004). Results from that project are presented here for numbers of Common Scoter and Red-throated Divers in Liverpool Bay. These estimates were calculated for surveys from November 2001 to May 2003.

Data from aerial surveys were analysed using the software Distance 4.0 (see Webb et al. 2004). For all species, for each survey, half-normal models with zero adjustments and stratified by cluster size provided the best fit to the data on the basis of minimising the Akaike Information Criterion. ‘Observer’ was initially included as a covariate in the models, but did not improve the fit of the models and was therefore excluded. Bootstrapping, re-sampling transects as samples with replacements, was used to increase the precision of the estimates of 95% confidence limits for all abundance estimates. Global detection functions, estimates of cluster size and encounter rate were made separately for each aerial survey.
3 RESULTS

3.1 Numbers of birds

Total numbers of birds encountered during the aerial surveys for the All Wales Common Scoter Survey during 2002/03 are presented in Tables 2-7. Note that these are not the absolute numbers present in the survey area but the number detected (an increasing proportion of birds are missed with increasing distance from the aircraft; see methods).

By far the most numerous species encountered during aerial survey was Common Scoter, though this will, in part, be a result of the relative ease of detecting large flocks of a black bird even in the outer distance bands; other species, such as gulls and particularly divers, will be less visible at that range owing to both their plumage colour (more similar to the sea) and because they are less likely to aggregate into large flocks.

Distant scoter are not safely identified specifically as Common Scoter, as they may not be distinguishable from Velvet Scoter Melanitta fusca at that range, particularly within mixed flocks. The vast majority of birds in Bands A and B can, however, be identified to species – and any Velvet Scoter in flight in band C would be readily distinguished. Of over 80,000 scoter recorded during the survey in 2002/03, it is estimated that at least half were sufficiently close to the aircraft to distinguish any Velvet Scoter present. Given that only one Velvet Scoter was identified from this total, it has been assumed that the vast majority of scoter present were Common Scoter.

Large numbers of scoter were already present in August, the majority in the Shell Flat area, though notable concentrations were also recorded in Colwyn, Cardigan and Carmarthen Bays (Table 8). Numbers had risen markedly by November and, in most areas, remained in roughly similar numbers until February: numbers in Colwyn Bay were notably consistent over this period, ranging between 6,100 and 7,400. The majority of the remainder were located in the Shell Flat area, though numbers there ranged between 5,000 and 14,000. Within Liverpool Bay, Conwy held over 1,000 December as did the Ribble on two occasions: the count at the latter site in May was notable, given that this was the peak count in that area for the winter and represented almost the total number in Liverpool Bay as a whole.

Divers (Red-throated Diver Gavia stellata and those not identified to species) were largely absent in August and May, and varied between 75 and 230 during November to February. Although a relatively small proportion (27%) was identified to species, all were Red-throated Divers and it is believed that the vast majority of unidentified birds were likely to be of this species also. Cardigan, Conwy, Colwyn, Formby and Ribble each held 30-40 birds on at least one occasion – around the maximum an any individual site, with the exception of 130 in Colwyn in January – although numbers were not present consistently at any of these sites.

Between 800 and 1,000 auks were recorded in each month from August to January, though there was an apparent influx in November, when almost 3,000 were encountered. Fewer than 500 remained in February and only 200 in May. The majority of auks encountered are believed to have been Guillemots Uria aalge and Razorbills Alca torda. No Little Auks A. alle or Puffins Fratercula arctica were specifically identified, although a very small proportion of observations were suspected to be of these species.

Large numbers of gulls were recorded in most sites throughout the survey period, with 700-1,000 in most months, but considerably more in August (6,100) and November (3,400). Comorants (including Cormorant Phalacrocorax carbo and Shag Phalacrocorax aristotelis) numbered between 175 and 420 in the study area, the largest numbers occurring in August and February. Only small numbers (generally fewer than 20 individuals) of other seaducks – Scaup Aythya marila, Eider Somateria mollissima and Red-breasted Merganser Mergus serrator – and grebes were recorded.

Large numbers of other wildfowl, e.g. Wigeon Anas penelope, and waders were recorded in some months, normally encountered as large flocks on the mud or sandflats of the major estuaries or flying near the coast when moving between these sites.
### Table 2. Numbers of birds counted during aerial survey for the All Wales Common Scoter Survey, August 2002.

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<tr>
<th>Species</th>
<th>Barrow</th>
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<th>Colwyn</th>
<th>Red Wharf</th>
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### Table 3. Numbers of birds counted during aerial survey for the All Wales Common Scoter Survey, November 2002 (shaded columns indicate only partial coverage; see 2.2).

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Table 4. Numbers of birds counted during aerial survey for the All Wales Common Scoter Survey, December 2002 (shaded columns indicate only partial coverage; see 2.2).

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### Table 7. Numbers of birds counted during aerial survey for the All Wales Common Scoter Survey, May 2003.

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<td>61</td>
<td>333</td>
<td>333</td>
</tr>
<tr>
<td>grey gull spp (Herring or Common)</td>
<td>3</td>
<td>1</td>
<td>7</td>
<td>21</td>
<td>18</td>
<td>6</td>
<td>36</td>
</tr>
<tr>
<td>black-backed gull spp</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>large gull sp.</td>
<td>5</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td>gull sp.</td>
<td>15</td>
<td>30</td>
<td>191</td>
<td>32</td>
<td>117</td>
<td>58</td>
<td>443</td>
</tr>
<tr>
<td>Sandwich Tern</td>
<td>3</td>
<td>13</td>
<td>1</td>
<td>17</td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Arctic/Common Tern</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>tern sp.</td>
<td>2</td>
<td>8</td>
<td>19</td>
<td>1</td>
<td>30</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>auk sp.</td>
<td>65</td>
<td>20</td>
<td>7</td>
<td>64</td>
<td>20</td>
<td>11</td>
<td>187</td>
</tr>
</tbody>
</table>
Total numbers of Common Scoter in Liverpool Bay in 2002/03 exceeded 16,000 (the 1% threshold for international importance; Wetlands International 2003) on two occasions (Table 8). Numbers during the mid winter period (November to February) were considerably higher than in 2001/02 (Table 9); indeed, the peak from that winter was exceeded in three of the four winter months in 2002/03. Numbers were markedly higher in 2002/03 in both of the two key sites of Shell Flat (Blackpool)/Ribble and Colwyn Bay; numbers in Cardigan Bay were broadly similar in the two winters.

**Table 8.** Numbers of Common Scoter recorded in 2002/03 (shaded cells indicate no or little coverage).

<table>
<thead>
<tr>
<th>Site</th>
<th>Aug</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>May</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrow</td>
<td>0</td>
<td>0</td>
<td>18</td>
<td>5537</td>
<td>14,002</td>
<td>0</td>
<td>36,159</td>
</tr>
<tr>
<td>Shell Flat</td>
<td>3785</td>
<td>4832</td>
<td>8003</td>
<td>1103</td>
<td>19</td>
<td>163</td>
<td>3923</td>
</tr>
<tr>
<td>Ribble</td>
<td>258</td>
<td>1103</td>
<td>9736</td>
<td>597</td>
<td>163</td>
<td>1142</td>
<td>1238</td>
</tr>
<tr>
<td>Formby</td>
<td>2</td>
<td>9</td>
<td>272</td>
<td>715</td>
<td>6</td>
<td>1004</td>
<td></td>
</tr>
<tr>
<td>Colwyn</td>
<td>997</td>
<td>7356</td>
<td>7436</td>
<td>6138</td>
<td>7237</td>
<td>0</td>
<td>29,164</td>
</tr>
<tr>
<td>Conwy</td>
<td>95</td>
<td>392</td>
<td>1424</td>
<td>425</td>
<td>634</td>
<td>5</td>
<td>2975</td>
</tr>
<tr>
<td>Red Wharf</td>
<td>59</td>
<td>102</td>
<td>174</td>
<td>112</td>
<td>571</td>
<td>5</td>
<td>1023</td>
</tr>
<tr>
<td>Liverpool Bay</td>
<td>5196</td>
<td>13,794</td>
<td>9034</td>
<td>12,647</td>
<td>24,301</td>
<td>1254</td>
<td>74,266</td>
</tr>
<tr>
<td>Cardigan Bay</td>
<td>541</td>
<td>4219</td>
<td>2211</td>
<td>1955</td>
<td>8926</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carmarthen</td>
<td>393</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>393</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6130</td>
<td>18,013</td>
<td>19,285</td>
<td>12,647</td>
<td>26,256</td>
<td>1254</td>
<td>83,585</td>
</tr>
</tbody>
</table>

Note, some data from flights in early December are not available, owing to a theft, resulting in the loss of data from both observers for Cardigan and Conwy Bays and from one observer for all other areas. Counts in parentheses constitute totals from one observer only.

**Table 9.** Numbers of Common Scoter recorded in 2001/02 (shaded cells indicate no or little coverage).

<table>
<thead>
<tr>
<th>Site</th>
<th>Dec*</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrow</td>
<td></td>
<td></td>
<td></td>
<td>19</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Blackpool/Ribble</td>
<td>4143</td>
<td>(686)</td>
<td>2449</td>
<td>5465</td>
<td>6861</td>
<td>7278</td>
</tr>
<tr>
<td>Formby/Burbo</td>
<td>340</td>
<td>(830)</td>
<td>0</td>
<td>462</td>
<td>176</td>
<td>3611</td>
</tr>
<tr>
<td>Colwyn</td>
<td>2412</td>
<td>(1675)</td>
<td>2383</td>
<td>3447</td>
<td>5194</td>
<td>2702</td>
</tr>
<tr>
<td>Conwy</td>
<td></td>
<td>(n/a)</td>
<td>1279</td>
<td>708</td>
<td>594</td>
<td>839</td>
</tr>
<tr>
<td>Red Wharf</td>
<td>5</td>
<td></td>
<td>141</td>
<td>77</td>
<td>36</td>
<td>1</td>
</tr>
<tr>
<td>Liverpool Bay</td>
<td>6901</td>
<td>(3191)</td>
<td>6111</td>
<td>9791</td>
<td>13,207</td>
<td>11,041</td>
</tr>
<tr>
<td>Cardigan Bay</td>
<td>2890</td>
<td>(n/a)</td>
<td></td>
<td></td>
<td>3549</td>
<td></td>
</tr>
<tr>
<td>Carmarthen</td>
<td>7268</td>
<td>(2295)</td>
<td></td>
<td></td>
<td>12,724</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17,059</td>
<td></td>
<td></td>
<td>29,840</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The total numbers recorded in 2002/03 represent, however, only a proportion of the true total present. Numbers recorded in the distance bands nearest the aircraft were generally higher; since smaller flocks in particular are more easily detected (Table 10). In several months, the numbers recorded in the nearest band were lower than in the next band, suggesting movement of birds into this band - known to occur to some extent as birds are flushed in front of the advancing plane and have flown away from the flight path before they are observed. This was particularly marked in August - when it might be expected that some birds were moulting; several flocks were observed to fly, though other flocks were observed to be relatively large and dense. Estimates of the true numbers of Common Scoter in Liverpool Bay (from November 2001 to May 2003), calculated using 'distance analysis' are given in Table 11.
Table 10. Numbers of Common Scoter recorded in different distance bands during aerial survey in 2002/03 (three bands were used in August and November; the middle band was divided into two separate bands from December onwards).

<table>
<thead>
<tr>
<th>Month</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>August</td>
<td>343</td>
<td>2903</td>
<td>2884</td>
<td></td>
<td>6130</td>
</tr>
<tr>
<td>November</td>
<td>2782</td>
<td>9580</td>
<td>5651</td>
<td></td>
<td>18013</td>
</tr>
<tr>
<td>December</td>
<td>4280</td>
<td>5853</td>
<td>5711</td>
<td>3441</td>
<td>19285</td>
</tr>
<tr>
<td>January</td>
<td>2422</td>
<td>4218</td>
<td>3614</td>
<td>2393</td>
<td>12647</td>
</tr>
<tr>
<td>February</td>
<td>7013</td>
<td>12054</td>
<td>6335</td>
<td>854</td>
<td>26256</td>
</tr>
<tr>
<td>May</td>
<td>612</td>
<td>376</td>
<td>260</td>
<td>6</td>
<td>1254</td>
</tr>
</tbody>
</table>

Table 11. Estimates of Common Scoter numbers (with 95% bootstrap confidence intervals) in Liverpool Bay, November 2001 to May 2003, calculated using Distance 4.0 (from Webb et al. 2004).

<table>
<thead>
<tr>
<th>Month</th>
<th>Estimate</th>
<th>Lower confidence interval</th>
<th>Upper confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 2001</td>
<td>16,088</td>
<td>10,840</td>
<td>23,876</td>
</tr>
<tr>
<td>December 2001</td>
<td>22,852</td>
<td>13,729</td>
<td>38,036</td>
</tr>
<tr>
<td>January 2002</td>
<td>18,779</td>
<td>9,029</td>
<td>39,059</td>
</tr>
<tr>
<td>February 2002</td>
<td>27,772</td>
<td>14,713</td>
<td>52,422</td>
</tr>
<tr>
<td>March 2002</td>
<td>23,059</td>
<td>13,228</td>
<td>40,195</td>
</tr>
<tr>
<td>April 2002</td>
<td>18,885</td>
<td>10,170</td>
<td>35,068</td>
</tr>
<tr>
<td>August 2002</td>
<td>5,289</td>
<td>1,895</td>
<td>14,759</td>
</tr>
<tr>
<td>November 2002</td>
<td>25,731</td>
<td>14,883</td>
<td>44,487</td>
</tr>
<tr>
<td>December 2002</td>
<td>37,286</td>
<td>18,626</td>
<td>74,638</td>
</tr>
<tr>
<td>January 2003</td>
<td>26,561</td>
<td>14,024</td>
<td>50,307</td>
</tr>
<tr>
<td>February 2003</td>
<td>79,136</td>
<td>43,568</td>
<td>143,740</td>
</tr>
<tr>
<td>May 2003</td>
<td>7,358</td>
<td>1,273</td>
<td>42,523</td>
</tr>
</tbody>
</table>

Numbers of counted divers were generally low, although they exceeded 50 (the 1% national threshold for Red-throated Diver in Britain; Kershaw & Cranswick 2003) on three occasions (Table 12).

Table 12. Numbers of divers recorded in 2002/03 (shaded cells indicate no or little coverage).

<table>
<thead>
<tr>
<th>Site</th>
<th>Aug</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barrow</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Shell Flat</td>
<td>0</td>
<td>11</td>
<td>2</td>
<td>4</td>
<td>7</td>
<td>24</td>
</tr>
<tr>
<td>Ribble</td>
<td>0</td>
<td>34</td>
<td>27</td>
<td>13</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>Formby</td>
<td>0</td>
<td></td>
<td>3</td>
<td>36</td>
<td>40</td>
<td>79</td>
</tr>
<tr>
<td>Colwyn</td>
<td>2</td>
<td>29</td>
<td>25</td>
<td>130</td>
<td>14</td>
<td>200</td>
</tr>
<tr>
<td>Conwy</td>
<td>2</td>
<td>38</td>
<td>2</td>
<td>12</td>
<td>7</td>
<td>61</td>
</tr>
<tr>
<td>Red Wharf</td>
<td>0</td>
<td>9</td>
<td>3</td>
<td>17</td>
<td>7</td>
<td>36</td>
</tr>
<tr>
<td>Liverpool Bay</td>
<td>4</td>
<td>76</td>
<td>33</td>
<td>226</td>
<td>88</td>
<td>477</td>
</tr>
<tr>
<td>Cardigan</td>
<td>0</td>
<td>29</td>
<td>37</td>
<td></td>
<td>49</td>
<td>115</td>
</tr>
<tr>
<td>Grand Total</td>
<td>4</td>
<td>150</td>
<td>75</td>
<td>226</td>
<td>137</td>
<td>592</td>
</tr>
</tbody>
</table>
The numbers of divers detected in the different distance bands show a marked concentration in those bands nearest the aircraft, falling quickly in bands further from the plane (Table 13), indicating the greater difficulty in detecting these species and that the true numbers present were likely to have been considerably higher. Estimates of the true numbers of divers in Liverpool Bay (from November 2001 to May 2003), calculated using 'distance analysis' are given in Table 14.

**Table 13.** Numbers of divers recorded in different distance bands during aerial survey (three bands were used in August and November; the middle band was divided into two from December onwards)

<table>
<thead>
<tr>
<th>Month</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>August</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>96</td>
<td>54</td>
<td>0</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>42</td>
<td>27</td>
<td>6</td>
<td>0</td>
<td>75</td>
</tr>
<tr>
<td>January</td>
<td>92</td>
<td>117</td>
<td>17</td>
<td>0</td>
<td>226</td>
</tr>
<tr>
<td>February</td>
<td>91</td>
<td>46</td>
<td>0</td>
<td>0</td>
<td>137</td>
</tr>
</tbody>
</table>

**Table 14.** Estimates of numbers of divers (with 95% bootstrap confidence intervals) in Liverpool Bay, November 2001 to May 2003, calculated using Distance 4.0 (from Webb et al. in prep).

<table>
<thead>
<tr>
<th>Month</th>
<th>Estimate</th>
<th>Lower confidence interval</th>
<th>Upper confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 2001</td>
<td>208</td>
<td>123</td>
<td>352</td>
</tr>
<tr>
<td>December 2001</td>
<td>132</td>
<td>61</td>
<td>284</td>
</tr>
<tr>
<td>January 2002</td>
<td>150</td>
<td>82</td>
<td>273</td>
</tr>
<tr>
<td>February 2002</td>
<td>1,599</td>
<td>1,063</td>
<td>2,405</td>
</tr>
<tr>
<td>March 2002</td>
<td>933</td>
<td>627</td>
<td>1,389</td>
</tr>
<tr>
<td>April 2002</td>
<td>982</td>
<td>668</td>
<td>1,443</td>
</tr>
<tr>
<td>August 2002</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>November 2002</td>
<td>824</td>
<td>549</td>
<td>1,236</td>
</tr>
<tr>
<td>December 2002</td>
<td>268</td>
<td>173</td>
<td>415</td>
</tr>
<tr>
<td>January 2003</td>
<td>1,210</td>
<td>901</td>
<td>1,626</td>
</tr>
<tr>
<td>February 2003</td>
<td>702</td>
<td>354</td>
<td>1,390</td>
</tr>
<tr>
<td>May 2003</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
3.2 **Bird distributions**

3.2.1 **All bird observations**

Birds were widely distributed throughout the study area in most months, though favoured areas were in Colwyn and Conwy Bays and Shell Flat in most months (Figs. 3-8). Birds were more sparsely distributed in August, but, in early and mid winter, reasonably high encounter rates extended to the offshore regions of the survey area throughout much of Liverpool Bay. Few birds were encountered in February, other than concentrations in the three key areas above, and there were only very low densities of birds by May. Distributions in Cardigan Bay were also variable between months, though large numbers were consistently associated with the shallow sarns (sand banks) in the northern part of the bay.

3.2.2 **Common Scoter**

The main concentrations of this species were encountered in Colwyn Bay and over Shell Flat, these being the prominent sites in all months with the exception of May (Figs. 9-15). Smaller concentrations, over more restricted areas, were also present in Conwy Bay, in the northeast of Cardigan Bay and, in some months, off Formby Point and between the Ribble Estuary and Shell Flat.

The centres of distribution within these sites were markedly closer to shore at the start of the winter, moving further offshore as winter progressed. This was most notable on Shell Flat, where high encounter rates were recorded along the length of the sand bank in January and February. There was perhaps also a shift further offshore in Colwyn and Cardigan Bays, and larger numbers in Conwy and Red Wharf Bays as the winter progressed. The largest numbers off Formby Point were recorded later in the winter, although, because of the absence of data for mid winter, it is not clear if there is a progressive shift in distribution at this site also.

The distribution in August, although covering a much more limited area, showed that birds were tightly concentrated in offshore areas; the nearest birds to shore were encountered at 2-8 km from the coast at Shell Flat, Cardigan Bay, Carmarthen Bay and most of Colwyn Bay – areas that were strongly favoured by high numbers of birds three months later.

The vast majority of Common Scoter had left the area by mid May. The few birds that remained were tightly clumped in the middle of the area offshore from the mouth of the Ribble Estuary, an area little used during the winter.

3.2.3 **Divers**

Divers were more sporadically encountered throughout the study area (Figs. 16-21), particularly in the first half of the winter when relatively few birds were recorded. They appeared to favour areas further offshore than scoter, and particularly offshore from the mouth of the Ribble Estuary and in the Conwy Estuary in early winter. There was seemingly an influx of divers in February, where large numbers were recorded off the mouth of the Dee Estuary and extending in a more or less continuous distribution to the centre of Colwyn Bay, and off the west of the north Wales coast, in Conwy and Red Wharf Bays. Divers in Cardigan Bay were located offshore from the main estuary mouths or over the shallower sarns, though again were generally encountered 5-15 km offshore. Few divers were recorded over Shell Flat.

No divers were encountered in May.

3.2.4 **Gulls**

Six species of gull – Black-headed Gull *Larus ridibundus*, Common Gull, Lesser Black-backed Gull, Herring Gull, Greater Black-backed Gull and Kittiwake – were commonly recorded throughout the survey period (Figs. 22-27). The first five are found in large numbers at coastal and inland sites; Kittiwakes are generally pelagic and separate maps are therefore presented for this species (Figs. 28-33).

Gulls were encountered widely throughout Liverpool and Cardigan Bays, generally in relatively even density up to the offshore limit of the survey area. The highest densities were usually encountered immediately adjacent to the coast, e.g. in Morecambe Bay, off the Wirral, in Colwyn Bay and around the Ormes Heads and in Conway.
Bay. In several cases, this will have been in part to survey at low tide, when large numbers were encountered loafing on exposed intertidal areas, although large flocks were also encountered sat on the sea 1-2 km from shore off the mouths of small rivers and, presumably, around hot water and/ or sewage outflows. The map for February (Fig. 26) suggests a departure from this general pattern, with marked concentrations off the mouth of the Ribble (where large numbers are often observed on the intertidal areas beyond the survey area), but relatively few birds were encountered and the highest densities recorded in that month were low compared with other flights. In May, there were more obvious concentrations around and offshore from the Conwy and Ormes Heads.

Kittiwakes were generally encountered further offshore, though their distribution in any one month was rather patchy and there were marked variations between months. There was an obvious and reasonably discrete concentration of birds offshore from the Wirral and Formby in August, which was more widespread and extended further offshore in November. Birds were largely absent through the midwinter period, but occurred again in the central Liverpool Bay area in May, when obvious concentrations were, as in August, also found offshore from the western part of the North Wales coast.

The Irish Sea – and Liverpool Bay in particular – is known to be of importance for Little Gulls Larus minutus, particularly in early winter. Small numbers were encountered in most months, seeming to favour the areas offshore from Formby, the Ribble and Blackpool (Fig. 34).

3.2.5 Auks

Auks were encountered widely throughout the study area during course of 2002/03, although their distribution and relative density varied between months (Figs. 35-40). In late summer, birds were largely restricted to the western parts of Liverpool Bay – although there was an obvious aggregation offshore from the Wirral and Formby, and high densities were encountered over much of the 50-km westernmost transect in the north half of the Bay. Relatively high, though somewhat patchy, densities were encountered throughout much of Liverpool Bay in November and August, although Shell Flat, the mouth of the Ribble and the nearshore areas of the North Wales coast were generally avoided. Only low densities were encountered in any month in 2003, and distribution became generally further offshore from January to May. Distribution in Cardigan Bay was also variable and patchy, e.g. a marked concentration in the southern part of the survey area in November, compared with a more northerly distribution in January, and widely scattered observations in February.
Figure 3. Transects flown and locations of all bird observations, August 2002.
Figure 4. Transects flown and locations of all bird observations, November 2002.
Figure 5. Transects flown and locations of all bird observations, December 2002.
Figure 6. Transects flown and locations of all bird observations, January 2003.
Figure 7. Transects flown and locations of all bird observations, February 2003.
Figure 8. Transects flown and locations of all bird observations, May 2003.
Figure 9. Relative encounter rate for all observations of Common Scoter *Melanitta nigra* by 2x2 km blocks in August 2002.
Figure 10. Relative encounter rate for all observations of Common Scoter *Melanitta nigra* by 2x2 km blocks in November 2002.
Figure 11. Relative encounter rate for all observations of Common Scoter *Melanitta nigra* by 2x2 km blocks in December 2002.
Figure 12. Relative encounter rate for all observations of Common Scoter *Melanitta nigra* by 2x2 km blocks in January 2003.
Figure 13. Relative encounter rate for all observations of Common Scoter *Melanitta nigra* by 2x2 km blocks in February 2003.
Figure 14. Relative encounter rate for all observations of Common Scoter *Melanitta nigra* by 2x2 km blocks in May 2003.
Figure 15. Locations of all 3351 observations of 83,585 Common Scoter *Melanitta nigra* recorded during all months in 2002/03.
Figure 16. Relative encounter rate for all observations of divers *Gavia* spp. by 2x2 km blocks in August 2002 (no divers were observed in Carmarthen Bay in August 2002).
Figure 17. Relative encounter rate for all observations of divers Gavia spp. by 2x2 km blocks in November 2002.
Figure 18. Relative encounter rate for all observations of divers *Gavia* spp. by 2x2 km blocks in December 2002.
Figure 19. Relative encounter rate for all observations of divers *Gavia* spp. by 2x2 km blocks in January 2003.
Figure 20. Relative encounter rate for all observations of divers *Gavia* spp. by 2x2 km blocks in February 2003.
Figure 21. Locations of all 592 divers Gavia spp. recorded during all months in 2002/03.
Figure 22. Relative encounter rate for all observations of gulls *Larus* spp. by 2x2 km blocks in August 2002.
Figure 23. Relative encounter rate for all observations of gulls *Larus* spp. by 2x2 km blocks in November 2002.
Figure 24. Relative encounter rate for all observations of gulls *Larus* spp. by 2x2 km blocks in December 2002.
Figure 25. Relative encounter rate for all observations of gulls *Larus* spp. by 2x2 km blocks in January 2003.
Figure 26. Relative encounter rate for all observations of gulls *Larus* spp. by 2x2 km blocks in February 2003.
Figure 27. Relative encounter rate for all observations of gulls *Larus* spp. by 2x2 km blocks in May 2003.
Figure 28. Relative encounter rate for all observations of Kittiwake *Rissa tridactyla* by 2x2 km blocks in August 2002.
Figure 29. Relative encounter rate for all observations of Kittiwake *Rissa tridactyla* by 2x2 km blocks in November 2002.
Figure 30. Relative encounter rate for all observations of Kittiwake *Rissa tridactyla* by 2x2 km blocks in December 2002.
Figure 31. Relative encounter rate for all observations of Kittiwake *Rissa tridactyla* by 2x2 km blocks in January 2003.
Figure 32. Relative encounter rate for all observations of Kittiwake *Rissa tridactyla* by 2x2 km blocks in February 2003.
Figure 33. Relative encounter rate for all observations of Kittiwake *Rissa tridactyla* by 2x2 km blocks in May 2003.
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Figure 35. Relative encounter rate for all observations of all auks *Uria/Alca/Fratercula* spp. by 2x2 km blocks in August 2002.
Figure 36. Relative encounter rate for all observations of all auks *Uria/Alca/Fratercula* spp. by 2x2 km blocks in November 2002.
Figure 37. Relative encounter rate for all observations of all auks *Uria/Alca/Fratercula* spp. by 2x2 km blocks in December 2002.
Figure 38. Relative encounter rate for all observations of all auks *Uria/Alca/Fratercula* spp. by 2x2 km blocks in January 2003.
Figure 39. Relative encounter rate for all observations of all auks *Uria/Alca/Fratercula* spp. by 2x2 km blocks in February 2003.
Figure 40. Relative encounter rate for all observations of all auks *Uria/Alca/Fratercula* spp. by 2x2 km blocks in May 2003.
4 DISCUSSION

4.1 Winter 2002/03

Aerial survey in Liverpool and Cardigan Bays in winter 2002/03, as in the previous two winters, recorded large numbers of Common Scoter. Gross distribution was similar to those in previous winters, with the majority of birds favouring known locations. During the course of the winter, birds appeared to have moved further from shore, particularly over Shell Flat, consistent with an expected response of the birds having depleted the food most profitably foraged in shallower waters at the start of the winter; a pattern also observed in 2001/02 (WWT Wetland Advisory Service 2003).

Total numbers of Common Scoter in Liverpool Bay were the highest yet recorded during aerial survey, exceeding 12,000 in most winter months, with a marked influx in February 2003 when 24,000 birds were counted, by far the largest total yet recorded: the 14,000 over Shell Flat alone in that month surpasses the aerial survey total for of Common Scoter at any site in the UK to date.

Estimates of the numbers of Common Scoter in Liverpool Bay, based on ‘distance sampling’, suggest that the true total present was at least 25,000 during winter months in 2002/03 (and exceeded 20,000 in three months during 2001/02 also). Although a different survey technique – a ‘total count’, rather than distance sampling – was used in 2000/01, counted numbers and distribution were similar, and it is highly likely that numbers present during that winter were similar to those in the subsequent two years. Thus, it is clear that Liverpool Bay as a whole is of international importance, supporting in excess of 16,000 birds (the 1% threshold for international importance for this species; Wetlands International 2003), and qualifies for designation as a Special Protection Area (SPA) under the EC Birds Directive (79/409/EEC).

A remarkable total of 79,000 Common Scoter was estimated for February 2003 in Liverpool Bay – considerably exceeding the previous estimates for this species in Great Britain as a whole (50,000-65,000; Cranswick in press). It is likely that that numbers at individual sites within the Bay, particularly Colwyn Bay and Shell Flat, also exceeded the 1% international threshold at this time. It should be noted, however, that the confidence intervals for these estimates were relatively large, a consequence of the very clumped nature of the species’ distribution in Liverpool Bay.

No estimates of total numbers using ‘distance’ are available for Cardigan Bay. Although the extrapolated figures must be calculated for each survey separately (given varying survey conditions, distribution, flock size etc), it is not unreasonable to expect that numbers there were also between two and three times the counted total, giving a total of 4000-5000 in most months, and perhaps exceeding 10,000 in November 2002.

The first aerial survey of birds during late summer was undertaken in August 2002, and noted the presence of reasonably large numbers of Common Scoter. The species is known to moult at this time – when flight feathers are dropped simultaneously and, as with other species of wildfowl, they are flightless for a period of 4-6 weeks. Although a proportion of birds were observed to fly during the August survey, the observation of several large dense flocks is perhaps indicative of moult birds; the distribution of birds at the key sites, generally occurring much further from shore than in November, also supports this suggestion and concurs with observations in the Kattegat, Denmark where it is thought that Common Scoter occupy sites further from potential sources of disturbance given their increased vulnerability while flightless (AD Fox & IK Petersen pers. comm.). Aerial survey in the Kattegat of moulting birds has also noted that moulting birds dive - rather than fly - when the aircraft approaches (IK Petersen pers. comm.) and it might be expected, therefore, that fewer birds would be located immediately adjacent to the flight path. Forward visibility from the type of aircraft used in the UK to view the sea is much poorer than in models used in Denmark and thus it is not known if birds dived during the August survey in Liverpool Bay.

Very few Common Scoter remained by mid May 2003. Large numbers were recorded in mid April in 2002, suggesting that there is a rapid departure of wintering birds from Liverpool Bay between mid April and mid May.

Numbers of divers were relatively small but exceeded the 1% national threshold for Red-throated Diver (the species which most observations are likely to represent). The UK Government has identified a series of guidelines for the selection of Special Protection Areas (SPAs) that includes areas used regularly by 1% or more of the Great Britain population of a species listed in Annex 1 of the Birds Directive (Stroud et al. 2001). If these
guidelines, originally established for terrestrial sites, are used in the marine environment also (as has occurred for the classification of the UK’s first marine SPA, for Common Scoter in Carmarthen Bay), all sites with 50 or more Red-throated Divers, an Annex 1 species, would qualify for SPA designation. The numbers of all divers in Liverpool Bay, calculated by distance analysis, greatly exceeded this figure during all winter months, with between 700 and 1600 birds (the vast majority of which are likely to be Red-throated) in most months in 2001/02 and 2002/03. Divers were not systematically recorded during 2000/01, although large numbers were present during February 2001 (PA Cranswick, L Smith pers. obs).

Aerial survey data suggest that Liverpool Bay is used by large numbers of auks in early winter, though there was no marked moulting or post-breeding aggregation within the survey area as has been recorded at other sites around the UK. Numbers and distributions varied to some extent between months, presumably as birds followed the varying distributions in their fish prey. Kittiwake distributions often matched the auk distribution; individual Kittiwakes were often associated with small groups of auks (PA Cranswick, pers. obs.) suggesting an association between these species.

Gulls were widely distributed throughout the offshore the parts of the study in relatively low densities: most birds were observed flying singly or in small groups, with occasional concentrations around fishing or other vessels.

No other species were recorded in significant numbers away from the immediate vicinity of the coast.

4.2 Future work

The following recommendations are made for survey work:

- Aerial survey should be continued in the Liverpool, Cardigan and Carmarthen Bays to detect between-year variations in numbers that might be expected to arise from cyclic changes in food abundance and distribution, particularly in relation to the boundary placement for a marine SPA;

- Aerial survey should aim to cover the whole of Liverpool Bay (from Anglesey to Morecambe Bay) in a short period given the use of many sites within this area by Common Scoter and the possibility of movements between these;

- Consideration should be given to extending aerial survey coverage westward off the north coast of Anglesey, and to more regular coverage in the northern parts of the survey area - particularly off Walney and in Morecambe Bay - to assess whether these areas might be included as part of any marine SPA;

- A spring (April) survey should be undertaken in view of the marked shift in distribution of Common Scoter in Liverpool Bay in April, to identify the relative importance of different areas, the extent of seasonal variation, and the integrity of these sites;

- A late autumn (August) survey should be undertaken at all sites to identify the importance of these areas for moulting Common Scoter; and

- Exploratory surveys of the key concentrations should be undertaken at other times of day to assess whether differences in distribution exist at these times (though recognising the limitations on data collection at this time because of poorer visibility).
5 REFERENCES


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