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Archive Report No. 016

Waders and wildfowl on the Ythan Estuary 2006/2007

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ARCHIVE REPORT

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Waders and wildfowl on the Ythan Estuary 2006/2007

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This report should be quoted as:

Patterson, I.J. and Thorpe, A.W. 2007. Waders and wildfowl on the Ythan Estuary 2006/2007. *Scottish Natural Heritage Archive Report No. 016.*

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ARCHIVE REPORT

Summary

Waders and wildfowl on the Ythan Estuary 2006/2007

Archive Report No. 016
Contractor: Aberdeen University
Year of publication: 2015

Background

Counts of waders and wildfowl on the Ythan estuary were made from 7 July 2006 to 23 June 2007, using the same methods as those used in the past, to enable the data to be comparable; a systematic survey from the estuary mouth to Logie Buchan bridge (Figure 1). Fortnightly counts and the distribution of birds over the estuary are shown in detail for each species.

Main findings

- The peak monthly mean count of common eiders *Somateria mollissima* in spring decreased from 3,168 in May 2006 to 2,556 in May 2007. The peak monthly mean total of other species also decreased considerably, from 11,581 (September 2005) to 8,959 (September 2006). The overall mean total of birds other than eiders over the whole autumn and winter (August to February) decreased from 6,516 in 2005/06 to 5,244 in 2006/07. There was also a decrease in both the peak and winter median counts of most individual waterfowl and wader species between 2005/06 and 2006/07.
- The distribution of birds over the estuary was determined in greater detail than in previous surveys and their density in 35 separate sub-sections was calculated. Distribution maps were presented for bar-tailed godwit *Limosa lapponica*, curlew *Numenius arquata*, dunlin *Calidris alpina* and redshank *Tringa totanus*. It was not possible to relate bird densities to algal cover since no aerial photograph was taken in summer 2006.
- The peak size of the eider population in 2007 (3,262) was 24.1% lower than in 2006 (4,297). The estimated total population (the sum of the separate peaks of males, females and yearling males) was the same as the peak population, since the separate categories all reached their highest numbers on the same date (15 May). The estimated number of breeding pairs decreased, by 24.9% from 1,533 in 2006 to 1,151 in 2007. The sex ratio of 1.44:1 (males:females) was lower than that in 2006 (1.53), while breeding output decreased, from 56 in 2006 to 18 in 2007, probably through poor survival of ducklings after hatching.
- The percentage cover and biomass of algae were measured at 10 sites on the estuary. Percentage cover was higher in downstream sites than in upstream ones and declined steadily after mid-August. In contrast, those patches of algal mat which retained their cover tended to have around the same weight of algae per unit area, irrespective of their position on the estuary, with relatively little decrease over the survey period.

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Table of Contents **Page**

1. INTRODUCTION

This report describes surveys which continue a monitoring programme which started in 1989/90, with the objective of monitoring the bird populations of the Ythan estuary by means of twice-monthly surveys of numbers and distribution. It is envisaged that the monitoring will continue, so this report should be considered as an interim one. A final report will be submitted when the monitoring is brought to an end.

The surveys carried out in 2006/07 fall into four distinct categories:

Counts of waders, wildfowl and other water birds, and their general distribution;
The detailed distribution of selected species, to be related to algal cover;
Detailed monitoring of the common eider *Somateria mollissima* population;
Measurement of algal cover and biomass throughout the estuary.

Since these surveys have different methodologies, each survey is presented in a separate section, so that the methodology immediately precedes the results of the survey and can be consulted readily.

In the interests of brevity, and because there is unlikely to be confusion of related species on the Ythan, short forms of bird names (e.g eider for common eider) will be used in the text and tables. Full names, as recently revised by the BOU, are given in Appendix 1.

2. WADER AND WILDFOWL COUNTS ON THE YTHAN ESTUARY 2006/2007

2.1 Introduction

Counts were carried out from 7 July 2006 to 23 June 2007, using the same methods as in previous years. The counts included waders, wildfowl (swans, geese and ducks) and other water birds, such as cormorants and herons, but excluded seabirds, such as gulls. Since eiders are an important qualifying species of the SPA, they were considered separately in the analysis of the data.

2.2 Methods

2.2.1 Field survey

Eiders were counted at high tide, when they were roosting on the shore or in sheltered bays, so that errors due to movement and diving would be minimised. All of the other species were counted at low tide, when they were feeding and so were dispersed over the intertidal area; roost counts at high tide were not practicable because roost sites were dispersed (some of them not known) and because some waders were known to feed in fields at high tide in mid-winter. Eiders were counted by I.J. Patterson and other species by A.W. Thorpe.

All surveys started at the estuary mouth and proceeded upstream, so as to minimise the risk of the count being curtailed by the incoming tide. Counts were made from standard observation points (Figure 1) and the counts were subdivided into nine areas of the estuary (Figure 1), so that the general distribution of each species could be described. The observer moved quickly by car from one observation point to the next, so as to minimise errors due to birds moving between sections during the survey. Any such movements seen while driving were noted and allowed for in the counts.

2.2.2 Data analysis

The count data were recorded on a pro-forma recording sheet and later stored on computer in an Excel spreadsheet. At the end of the survey year (after 30 June) the data were checked, sorted and analysed, using Excel functions.

2.3 Results

The count data are tabulated by species in Appendix 1. This section presents the results of analyses of the data.

2.3.1 Total number of birds on the estuary

The total number of birds of all species was calculated for each count date and the mean taken for each month. Eiders were considered separately from the other species (Table 2.1).

Table 2.1 *The monthly total numbers of eiders and birds of other species on the Ythan estuary in 2006/07*

Month	Eiders	Other species	Total
2006			
July	1,273	2,540	3,813
August	323	4,196	4,519
September	587	8,959	9,546
October	852	8,244	9,096
November	906	5,927	6,833
December	790	3,159	3,949
2007			
January	554	2,135	2,689
February	475	4,091	4,566
March	436	3,103	3,539
April	1,344	1,465	2,809
May	2,556	602	3,158
June	1,196	750	1,946

The total number of birds of all species on the estuary was higher in September and October than in any other month (Figure 2), due mainly to large numbers of golden plovers *Pluvialis apricaria* and lapwings *Vanellus vanellus*.

2.3.2 Comparison between 2005/06 and 2006/07

2.3.2.1 Total number of birds

The monthly mean numbers of birds of all species (including eiders) were lower in 2006/07 than in the previous year in all but one of the 12 months, being higher only in October. The peak of 9,546 birds in September 2006 was also much lower than the peak in 2005/06 (12,859; also in September).

Eiders also decreased between the two years, with numbers lower in 2006/07 than in the previous year in all of the 12 months. Species other than eiders, however, showed little overall change, with higher mean numbers in 2006/07 in six of the 12 months and lower numbers in six. However, as was emphasised in previous reports, such peak monthly values

may be affected by year-to-year differences in the timing and extent of migratory movements and so may not be meaningful in making comparisons between years.

A less variable measure, however, the mean monthly total of species other than eiders over the whole autumn and winter (August to February), also showed a decrease, from 6,516 in 2005/06 to 5,244 in 2006/07.

2.3.2.2 Individual species

For each of the commonly-recorded species (those which in most years were recorded on at least 10 of the 14 winter count dates), the mean of the three highest counts in 2006/07 was compared with the same measure for the previous year (Table 2.2).

Table 2.2 *The mean of the three highest counts of each common species in 2006/07, compared to 2005/06.*

Species	*2005/06*	*2006/07*	*Change*
Waterfowl			
Mute Swan	47	48	+
Shelduck	149	192	+
Wigeon	596	497	-
Teal	101	52	-
Mallard	50	94	+
Eider	3,328	2,584	-
Goldeneye	32	23	-
Merganser	22	22	=
Cormorant	47	59	+
Heron	34	41	+
Waders			
Oystercatcher	581	537	-
Ringed plover	55	32	-
Golden plover	3,283	3,309	+
Lapwing	4,960	3,476	-
Knot	428	120	-
Dunlin	933	449	-
Bar-tailed godwit	50	42	-
Curlew	723	1,983	+
Redshank	1,365	1,009	-
Turnstone	48	43	-

Of the eight wildfowl species, three showed increases, four showed decreases and one stayed the same. Of the 10 wader species, eight decreased and only two (golden plover and curlew *Numenius arquata*) increased. The data are of course subject to the difficulty that some species (e.g. golden plover and lapwing) occurred in unusually large numbers in only a few counts out of the whole year, so that peak counts can be misleading. Peak counts were, however, appropriate for eiders and shelduck *Tadorna tadorna*, which reached predictable seasonal peak numbers in the nesting season (usually in May).

An alternative measure, the median of the winter counts (1 September to 31 March; Table 2.3) is not affected by the size of individual peak counts (Patterson and Cosgrove 1998).

Table 2.3 *The median of the winter counts of each common species in 2006/07, compared to 2005/06.*

Species	Median 2005/06	2006/07	Change
Mute Swan	14	25	+
Wigeon	346	189	-
Teal	4	0	-
Mallard	11	20	+
Goldeneye	17	11	-
Merganser	13	11	-
Cormorant	8	8	=
Heron	8	9	+
Waterfowl total	421	273	-
Oystercatcher	448	345	-
Ringed plover	10	6	-
Golden plover	615	661	+
Lapwing	2,003	1,711	-
Knot	230	56	-
Dunlin	355	214	-
Bar-tailed godwit	36	28	-
Curlew	543	351	-
Redshank	683	572	-
Turnstone	27	14	-
Wader total	4,950	3,958	-
Overall total	5,371	4,231	-

Of the six species of wildfowl which normally have their highest numbers in winter (ie excluding eider and shelduck), four showed a decrease in their median counts, while two (mute swan *Cygnus olor* and mallard *Anas platyrhynchos*) increased. Of the 10 wader species, nine decreased and only one (golden plover) increased. The totals of the median values decreased for both waterfowl and waders, with a consequent decrease overall.

2.4 Discussion

As in previous years, the large month-to-month fluctuations in the numbers of some of the most abundant species on the estuary makes it difficult to compare overall bird numbers between 2005/06 and 2006/07, especially since many of the fluctuations may have been the result of large-scale movements, e.g. cold-weather effects or post-breeding dispersal, not related to conditions on the Ythan itself. Year-to-year comparisons must therefore be interpreted cautiously.

There was an overall decrease in total bird numbers between the two years, with numbers lower in 2006/07 than in 2005/06 in all but one of the 12 months. The mean total number of birds (of species other than eiders) between August and February was also lower than in the previous year. A majority of the individual waterfowl species showed a decrease in both their peak and winter median numbers. The two main breeding duck species showed opposite trends; eiders showed a decrease in their peak counts while shelducks increased. As with the waterfowl, almost all of the common wader species showed a decrease in both their peak and winter median numbers. It is not clear what factors might be associated with this general picture of decrease. It may be associated with a national trend, but this cannot be checked until the national WeBS count data are published. There may have been unusually large amounts of green algae in summer 2006, but no measurement of the area covered by algae was made that summer. However, the lower eider numbers may well be related to a decline in mussels associated with algal cover of the musselbeds (section 4).

3. THE DISTRIBUTION OF WATERFOWL ON THE YTHAN ESTUARY

3.1 Introduction

There has been concern for many years about the growth of green algae on the intertidal areas of the Ythan estuary and the effects of the algal cover on the ecosystem (Raffaelli *et al*. 1999). The situation has been monitored by regular aerial photographic survey of the extent of the algae in summer and by counts of waterfowl throughout the year. Regular twice-monthly low tide counts of wildfowl, waders and other waterbirds started in 1989 and have continued without a break until the present. During these counts, the estuary was divided into nine sections (Figure 1), so that the birds' distribution, in addition to their total numbers, could be monitored. The division of the estuary into only nine sections, however, gave only a coarse distribution, capable of detecting changes only if they were fairly major. A detailed comparison of the birds' distribution with that of the algae in any given year was also limited to a rather coarse scale. Consequently, SNH decided to implement a more detailed survey of bird distribution, using a much finer scale.

The aim of the present survey was to monitor the distribution of waterfowl on the Ythan estuary by twice-monthly low tide counts which distinguished a much larger number of subdivisions than the original nine, and to calculate the mean density of each species in each subdivision. These data could then be used to compare the bird distribution with that of green algae over the same set of subdivisions.

3.2 Methods

3.2.1 Bird counts and mapping

The division of the estuary into arbitrary grid squares was not considered to be practicable, since it would be difficult to identify the boundaries of the squares in the field and thus very difficult to allocate members of widespread diffuse flocks to particular squares. In addition, it was found in trials with different grid systems (e.g. one-hectare; four-hectare), that many squares had part of their area in the river or above the high water mark. Instead of using a grid system, the original nine sections (apart from the three smallest ones) were divided into two or more (up to five) sub-sections (Figure 3). Wherever possible, the divisions between sub-sections were made at visible features, such as tributary streams, bridges, etc, which were easily identifiable in the field.

The sub-section naming system was based on the names of the original nine sections (Figure 1), with the first two letters of each name used as its abbreviation in data tables. Within each subdivided section (i.e. omitting Tarty, Machar and Logie, which were not subdivided), the subsections were numbered from their downstream end. Within each

subsection, its two intertidal areas, i.e. east and west of the low tide river channel, were distinguished as separate count units. Thus, the first pair of count units at the mouth of the estuary were MO1W (Mouth, subsection1, west) and MO1E (Mouth, subsection1, east). In the data tables (Appendix 2, Tables 1 – 5), the resulting 35 count units are listed in order from the estuary mouth upstream, in the direction followed during the counts.

The bird counts were carried out in the same way as in previous years, starting at the estuary mouth at low tide and proceeding upstream, so as to minimise the risk of the count being curtailed by the incoming tide. Counts were made from standard observation points (Figure 1), with the observer moving quickly by car from one point to the next, so as to minimise errors due to birds moving between areas during the survey. Any such movements seen while driving were noted and allowed for in the counts.

The bird counts were recorded in the field on outline maps which showed the section and subsection divisions, using standard two-letter codes for species names. Although only common, widespread mudflat-feeding species, namely bar-tailed godwit *Limosa lapponica* (referred to in error as black-tailed godwit in the statement of requirements), curlew, dunlin *Calidris alpina* and redshank *Tringa totanus*, were required by the survey specification to be investigated in detail, it was found to be more convenient to record all of the bird species on the same system.

3.2.2 Analysis

Following each count, the number of each species in each count unit was entered into an Excel spreadsheet, which allowed the data to be sorted by species at the end of the season. The mean number of each species over the winter (September to March inclusive) in each of the 35 count units was then calculated. The use of median rather than mean values might have been more appropriate, but it was found that the large number of zero counts in many of the count units meant that many median values were zero, even when a species had occurred in the count units concerned on several occasions. Mean values were thus found to be more sensitive to intermittent occurrences and were considered to give a better measure of distribution. These analyses were confined to the commoner bird species found on the estuary, i.e. those recorded on at least 10 of the 14 count dates in the winter period, since the less common species had a large majority of zero counts in their data sets.

The boundaries of the count units were mapped as polygons in ArcView GIS and their individual areas (in hectares) were measured. These values were then used to calculate the mean density of each bird species in each count unit, by dividing the mean number by the area of the unit.

Finally, the bird density data were entered into the attributes table of the subsection map in ArcView, so that they could be plotted on an outline map of the estuary.

3.3 Results

3.3.1 Count unit area

The areas of the count units varied considerably (Appendix 2, Table 1), from 1.3 ha (Inches, subsection 2, east) to 18.6 ha (Sleek, subsection 2, west), with a mean of 5.7 ha and a median of 4.5 ha.

3.3.2 Bird numbers and densities

Both the mean numbers (Appendix 2, Tables 2 and 3) and the mean densities (Appendix 2, Tables 4 and 5) of each bird species in each count unit have been tabulated, since the two types of data allow different assessments of the birds' distribution. The mean number of birds in a count unit indicates the importance of that area of the estuary to the species concerned, whereas the mean density can be taken to indicate the intensity of use of the area by the species. As an example, by far the largest mean number of wigeon *Anas penelope* was found in SL3W (Appendix 2, Table 2), but the highest mean density was on the directly opposite side of the river channel in SL3E (Appendix 2, Table 4), where fewer birds occupied a very much smaller area. Of the two measures of bird distribution, the density value is considered to be the most appropriate for comparison with the proportion of the count unit covered with green algae.

3.3.3 Plotting of bird distributions

The distributions of the four wader species identified in the specification for the survey, namely bar-tailed godwit, curlew, dunlin and redshank, are plotted in Figures 4 to 7. In these maps, the shading indicates relative density within the range of densities exhibited by the species, with darker shades showing relatively higher densities. The same shade does not indicate comparable densities between species.

The highest densities of bar-tailed godwits were found in the downstream parts of the estuary (Figure 4), with intermediate densities in two count units in the Sleek section. Curlews, in contrast were more widespread, with most high densities in the upper estuary, but with high densities also in the Inches section (Figure 5). Dunlin had the most restricted distribution of the four species, with high densities only in the upper estuary (Figure 6). Redshanks had their highest densities throughout a wide area in Machar, Snub and Haddo, in the upper part of the estuary, but there were also high densities in Tarty and Inches (Figure 7).

3.3.4 Comparison of bird and algal distributions

If the coverage of the estuary by green algae can be provided as ArcView files, the count unit polygons can be superimposed on the algal coverage to determine the proportion of each unit covered by algae. These values for coverage can then be compared with the bird number and density data in Appendix 2, Tables 2 to 5 (using their electronic (Excel) files). Unfortunately, no aerial photographic survey was undertaken in summer 2006, so this analysis cannot be carried out with the 2006/07 bird distribution data. However, a system for doing so is now in place, so the analysis can proceed in 2007/08, using the survey of algal coverage scheduled for summer 2007.

It is perhaps significant that of the four species whose distributions are plotted in Figures 4 to 7, three had their highest densities largely in the upper parts of the estuary, where algal coverage is generally considered to be less than on the downstream mudflats (Raffaelli *et al*. 1999). This might suggest that the birds were avoiding the areas with the greatest algal cover. However, in the absence of data on algal coverage in summer 2006, this suggestion must remain speculative.

4. THE EIDER POPULATION

4.1 Introduction

Since the eider is an important qualifying species of the Ythan Estuary, Sands of Forvie and Meikle Loch SPA, with an unusually large mainland-nesting population, additional counts were undertaken to determine the population size, sex ratio and breeding output of this species. Since part of the SPA eider population occurs on the sea coast between Collieston and the mouth of the Ythan estuary, it was necessary to count the birds in this area in addition to those on the estuary itself. Counts in previous years have shown that the annual peak in numbers can be brief, so weekly counts were made over the period when the peak was likely to occur.

4.2 Methods

The counting methods remained the same as in previous years, namely a direct count of the birds while they were roosting at high tide, in separate sections of the estuary (Figure 1), distinguishing males, females and yearling males (Patterson and Laing 1991). Counts of sea coast between Collieston and the estuary mouth were carried out on six occasions between 27 April and 4 June 2007, the period when the seasonal peak in numbers was expected to occur. The sex ratio, after the arrival of sufficient birds and before most females began to incubate, was determined from the count on 27 April. The number of fledged juveniles was counted by walking down the east shore of the estuary just before high tide on 2 August 2007. Most birds were coming ashore to roost on the east bank and so were within 20-30 m in good light, so that large juveniles could readily be distinguished from adult females, even moulting ones, by the adults' worn and faded wing covert and tail feathers. The juveniles on the sea coast between Collieston and the estuary mouth were counted the next day. The estuary count was repeated from the west shore at low tide on 8 August

4.3 Results

4.3.1 Population size

The total number of eiders on the Ythan, including the coast north to Collieston, reached a peak of 3,262 on 15 May (Table 4.1), almost two weeks later than in 2006 (3 May). As in 2004, 2005 and 2006 (but in contrast to earlier years), the different sex and age categories of the population reached their peak numbers on the same date; 2,069 adult males, 1,172 females and 21 yearling males (Table 4.1). The sum of the separate peak values (the estimated total population) was therefore the same as the peak count (3,262). The breeding population, estimated from the peak number of females less the estimated number of yearling females (assumed to be the same as that of yearling males) on the same day (i.e. 21 on 15 May), was 1,151 pairs. No correction could be made for the number of females which were incubating on that date, since there was no detailed study of nesting in 2007.

Table 4.1 *Counts of eiders on the Ythan Estuary and the coastline between Collieston and the estuary mouth in 2007. The peak count for each category is shown in bold.*

Date	Adult Males	Females	Yearling Males	Total
27 April	1,302	907	15	2,224
8 May	1,867	1,124	20	3,011
15 May	**2,069**	**1,172**	**21**	**3,262**
21 May	2,008	1,052	21	3,081
28 May	2,046	894	18	2,958
4 June	1,079	743	16	1,838

4.3.2 Sex ratio

The mean ratio of adult males (1,302) to all females (907) counted on 27 April was 1.44. If it is assumed that the number of yearling females was the same as that of yearling males (15) counted on the same day, the ratio among older birds was 1.46.

4.3.3 Number of young reared

The maximum number of fledged young counted on 2 and 8 August 2007 was 18, including one on the sea coast between Collieston and the estuary mouth. All but a few had reached the fully-feathered stage and were very likely to survive.

4.4 Discussion

The peak count of eiders in 2006 (3,262, on 15 May) was 24.1% lower than the peak in 2006 (4,297; Patterson 2006). The estimated total population was the same as the peak count, since the different categories of the population reached their highest numbers on the same day, as they did in 2004 - 2006. The peak number of males (2,069) was 19.7% lower than that in 2006 (2,578), and there were also 27.9% fewer females in 2007 (1,172, compared to 1,626 in 2006). The estimated breeding population (the peak count of females less the estimated number of yearling females) also decreased, by 24.9%, from 1,533 pairs in 2006 to 1,151 in 2007. The peak number of yearling males (21) was very much lower than in 2006 (93). It is not possible to determine whether this substantial decrease in the Ythan eider population was due to over-winter mortality or a failure to return to the area to breed. Since this is the second successive year with a substantial decline, it is clear that there has not been a rapid recovery from the low numbers in 2006, as happened in 1997 following a very low peak number (2,098) in 1996.

The peak in numbers on 15 May 2007 was much less sharp than in recent years, with only about 200 birds more than in the counts in the previous and succeeding weeks (Table 1).

The sex ratio (1.44:1) was lower than that in 2006 (1.53), and more similar to the ratios in 2005 (1.33), 2004 (1.36) and 2003 (1.35). The estimated ratio among adult birds (1.46) was also lower than the equivalent ratio in 2006 (1.64; Patterson 2006). This suggests that the sex ratio is returning closer to the level recorded in previous years.

Breeding output in 2007 (18 ducklings) was only a third of that in 2006 (56 ducklings), making 2007 the fourth successive year of declining output (from 222 in 2003, 104 in 2004, 96 in 2005 and 56 in 2006). Since nesting success was not monitored in detail during the 2007 nesting period, it is not possible to determine whether the low output was due mainly to low hatching success or high duckling mortality after hatching. However, it is possible, even

two months after the end of the nesting season, to detect whether successful hatching has occurred in a nest, although it is likely that nesting success will be over-estimated.

The main estuary-side nesting area was visited on 22 August 2007, to carry out a search for eider nests, in order to determine their success or failure. A search along parallel transect lines found 74 nests, of which 35 (47.3%) had hatched successfully. Even if this is an over-estimate, it suggests that a population with 1,151 breeding females, laying an average of around four eggs each (3.92 in 1996 – 2002), should have hatched around 2,000 ducklings. This suggests that the main losses occurred after hatching, possibly associated with cold, wet weather in combination with predation by gulls.

As was pointed out in 2006 (Patterson 2006), a potentially very important factor in the decline in the eider population may be the considerable growth of algae on the major musselbeds near the mouth of the estuary, where most of the eiders feed. As a result, the eiders' food supply must have declined substantially, and is likely to have been a factor in the decrease in numbers. It would be highly desirable to have a survey of both the intertidal and sublittoral musselbeds, to quantify the area of the beds and the density of the mussels, and compare these with earlier surveys. The survey could also attempt to identify the cause of any decline in mussel abundance.

5. ALGAL COVER AND BIOMASS

5.1 Introduction

Sampling of green algae on the Ythan estuary was undertaken to supplement a planned aerial survey of the extent of the algal beds. The sampling aimed to determine the percentage cover and biomass of algae within the beds, so that an estimate of the total biomass of algae on the estuary could be made.

5.2 Methods

Samples of algae were collected from representative parts of algal mats at 10 sites (Figure 8) distributed along the length of the estuary, omitting only the two most upstream sections (Machar and Logie), where there were no algal mats. To avoid undue disturbance to the substrate, samples were taken from the part of the main mat nearest to the shore, but far enough into algal-covered area for the measurements to be representative of the whole mat.

At each site, the percentage of the area covered by algal mat was estimated to the nearest 10% by eye. A metal quadrat, 0.25x0.25m ($1/16^{th}$ m^2) was thrown to establish a random position on an algal-covered area and the algae within it cut out with a sharp knife and placed in a labelled polythene bag. Later, the algal sample from each site was washed in fresh water to remove mud, stones, small invertebrates, etc and was squeezed and shaken vigorously to remove excess water, before being weighed to the nearest 5g.

5.3 Results

The raw data are tabulated in Appendix 3. This section presents the results of analyses of the data.

The percentage cover of algae in the lower part of the estuary (sites 1 – 5, downstream of Waterside Bridge; Figure 8) remained fairly constant at 80 – 90% until late August, but cover was consistently lower at the sites further upstream, where there was a peak in mid-August (Figure 9, upper). The percentage cover throughout the estuary declined steadily after late August.

The weight of algae in samples taken from covered areas varied greatly, both between sites and between sampling occasions at the same site (Appendix 3, Table 2). There were many instances where samples taken later in the survey period showed a higher weight than those taken earlier at the same site. This variation was almost certainly related to the uneven way in which the algal filaments were deposited as the tide fell, with multiple layers in some places. There was a sharp peak in the weight of algae per m^2 within covered areas in early August (Figure 9, lower), followed by a decline in late August and September. There was no consistent difference in the weight of algae in covered areas between upstream and downstream sites for most of the survey period, but in September samples from the upper part of the estuary were markedly lighter than upstream samples (Figure 9, lower).

The principal conclusion of the algal survey was that the main spatial variation was in percentage cover, which was higher in downstream sites than in upstream ones. There was no consistent difference between areas of the estuary in the weight of algae per unit area except at the end of the survey period, when upstream samples were lighter. Both percentage cover and the weight of algae per unit area were highest in August and declined sharply in September.

It was observed during the survey (as in the previous year) that algal mats had continued their spread on to the mussel-bed near the estuary mouth (site 1, Figure 8), extending right to the low water mark and even below it. Areas of former mussel-bed appeared to have been covered by silt, possibly as a result of reduced current speed induced by the algae, with dead mussels buried underneath. Some areas had also eroded down to a bare pebble layer, although it is not clear whether this was associated with algal cover.

6. REFERENCES

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Raffaelli, D., Balls, P., Way, S., Patterson, I., Hohmann, S. & Corp, N. 1999. Eutrophication-related trends in the ecology of the Ythan estuary, Aberdeenshire, Scotland. *Aquatic Conservation: Marine and Freshwater Ecosystems,* **9**: 219 - 236.

7. FIGURES

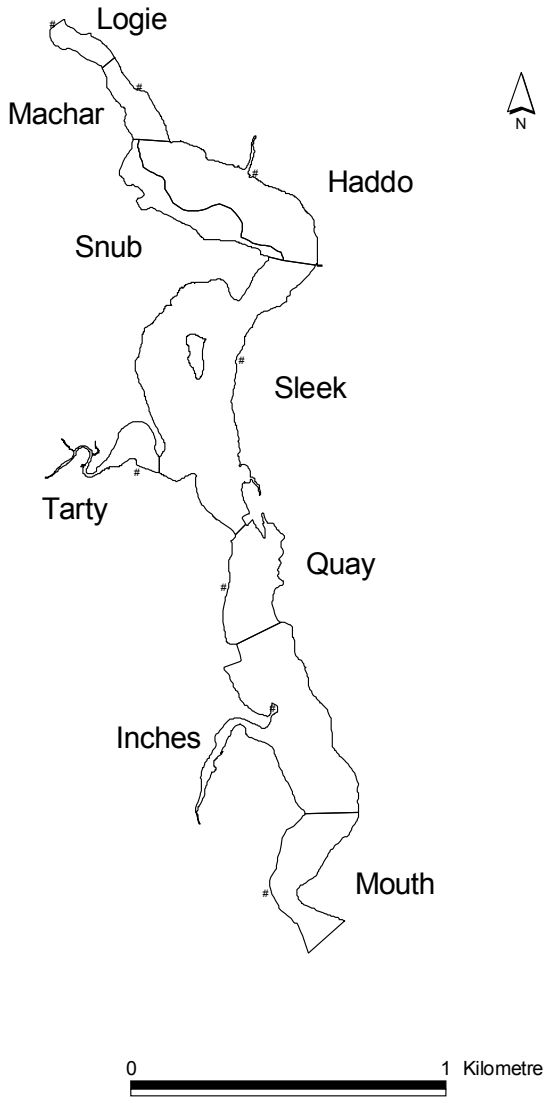


Figure 1. *The Ythan estuary, showing the counting sections (named) and count points (spots). The division between the Snub and Haddo sections is the centre of the low-water channel*.

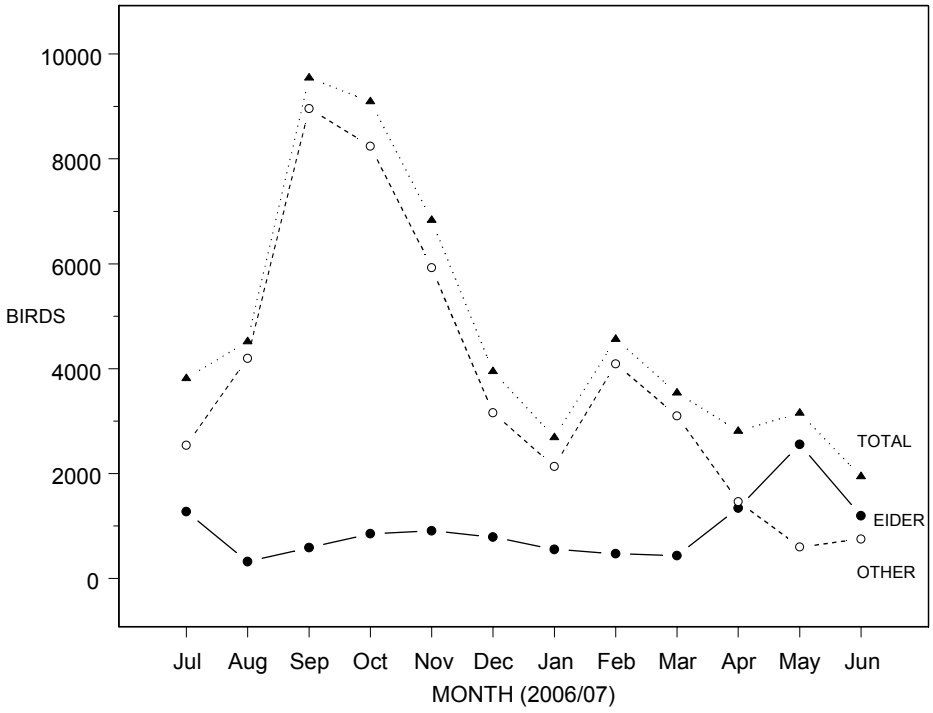


Figure 2. *The mean number of eiders (closed circles), birds of other species (open circles) and the total of birds of all species (triangles) on the Ythan estuary in 2006/07*

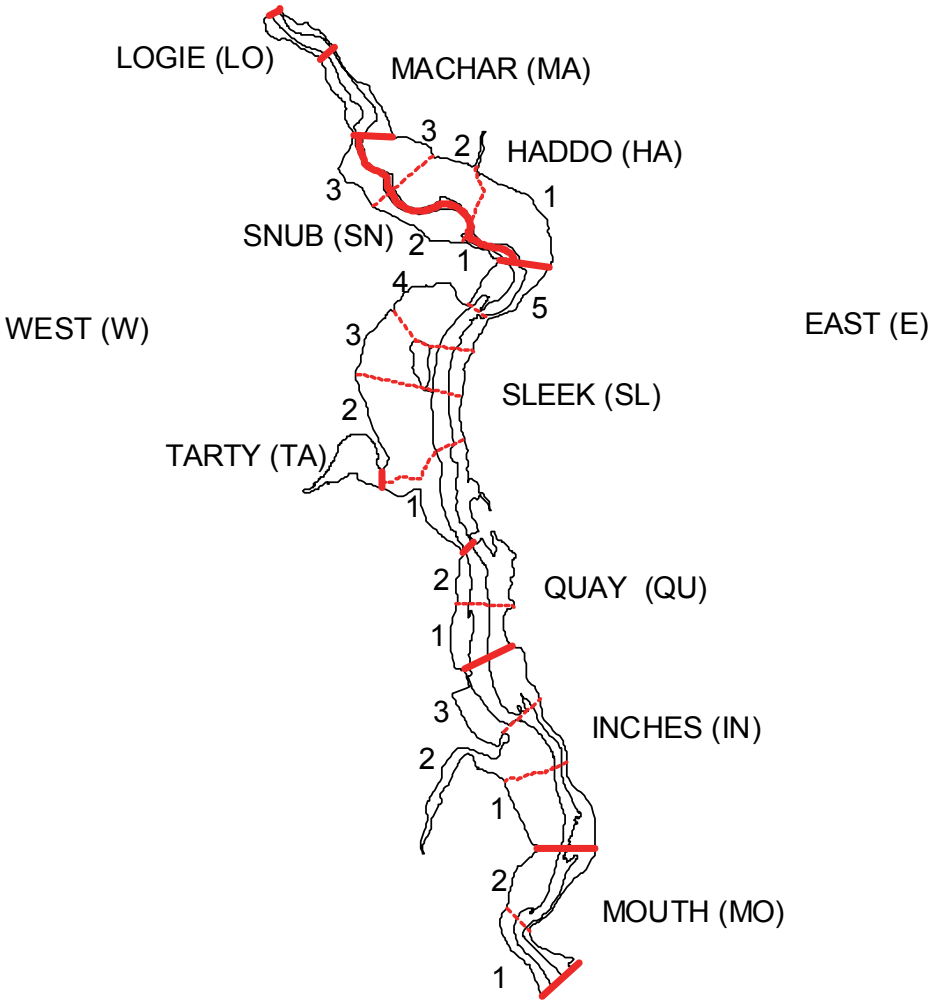


Figure 3. *The counting sections (named, with abbreviations used in Tables) and their sub-sections (numbered). Sections are separated by solid red lines and sub-sections by dotted red lines. Within each sub-section, the east and west shores are considered separately*.

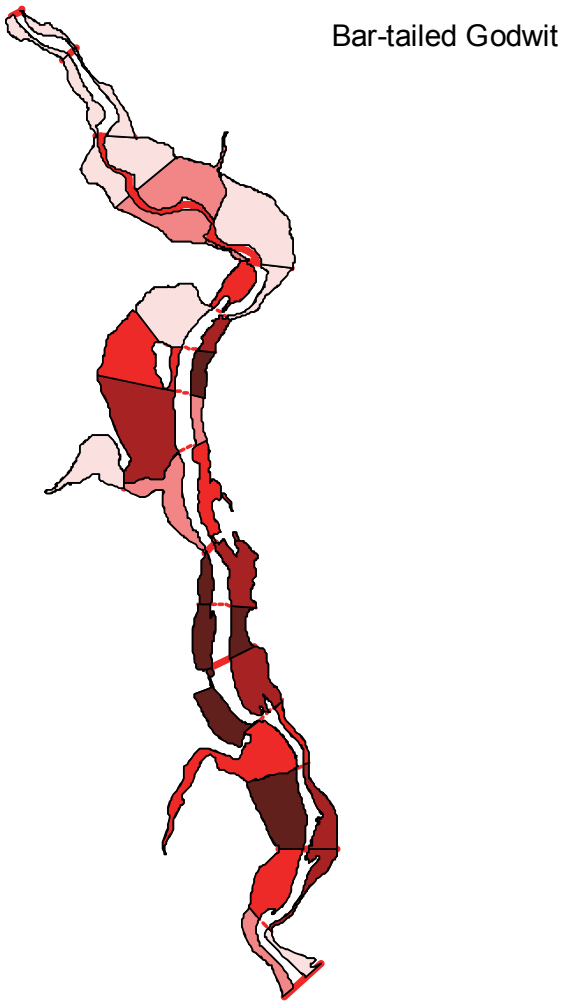


Figure 4. *The density of bar-tailed godwits (birds per hectare) on the Ythan estuary, September 2006 to March 2007. Darker colours show higher densities (values shown in Table 5)*.

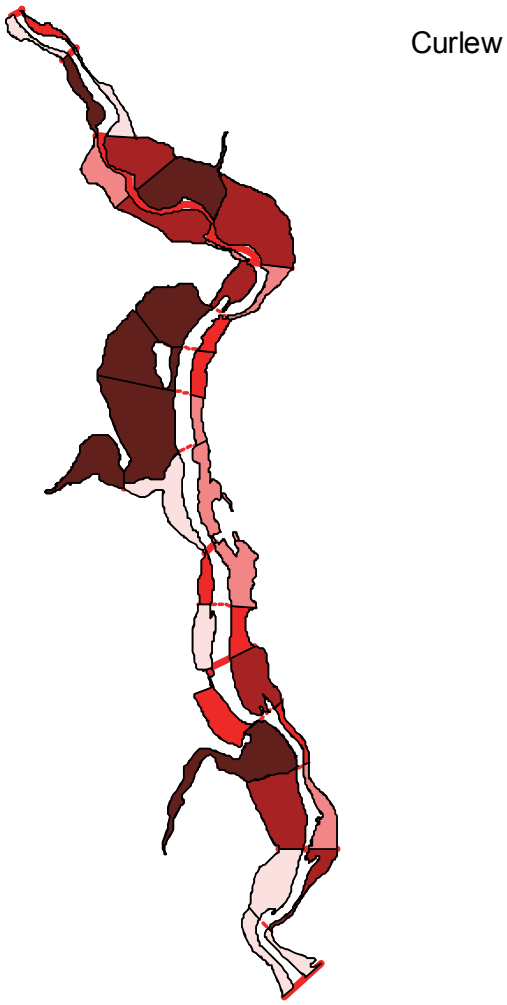


Figure 5. *The density of curlews (birds per hectare) on the Ythan estuary, September 2006 to March 2007. Darker colours show higher densities (values shown in Table 5)*.

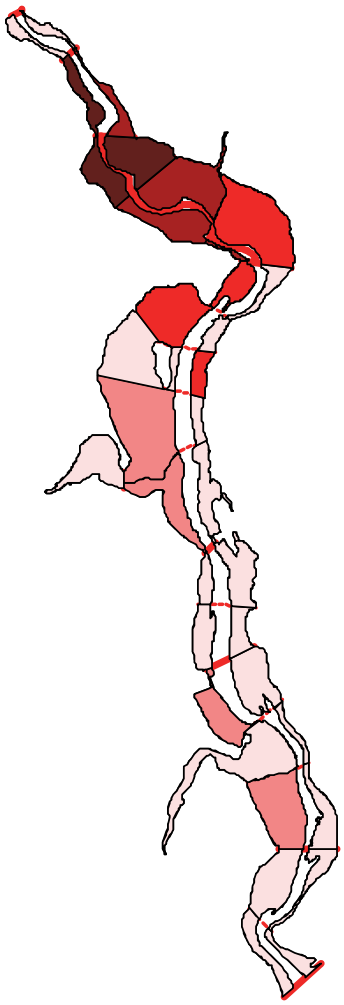


Figure 6. *The density of dunlin (birds per hectare) on the Ythan estuary, September 2006 to March 2007. Darker colours show higher densities (values shown in Table 5)*.

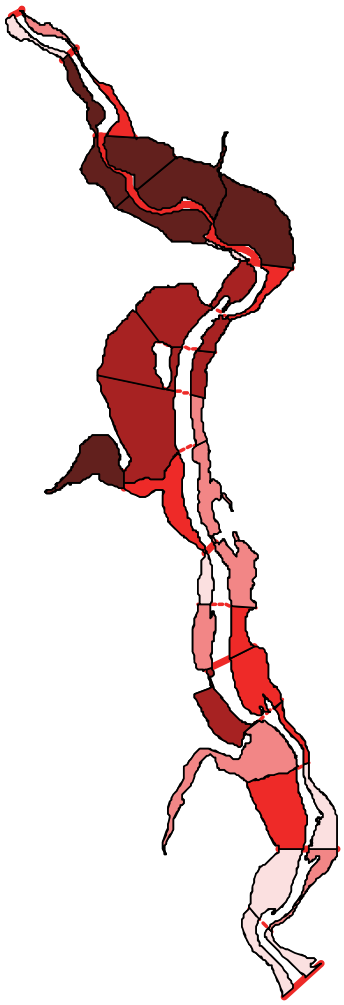


Figure 7. *The density of redshanks (birds per hectare) on the Ythan estuary, September 2006 to March 2007. Darker colours show higher densities (values shown in Table 5).*

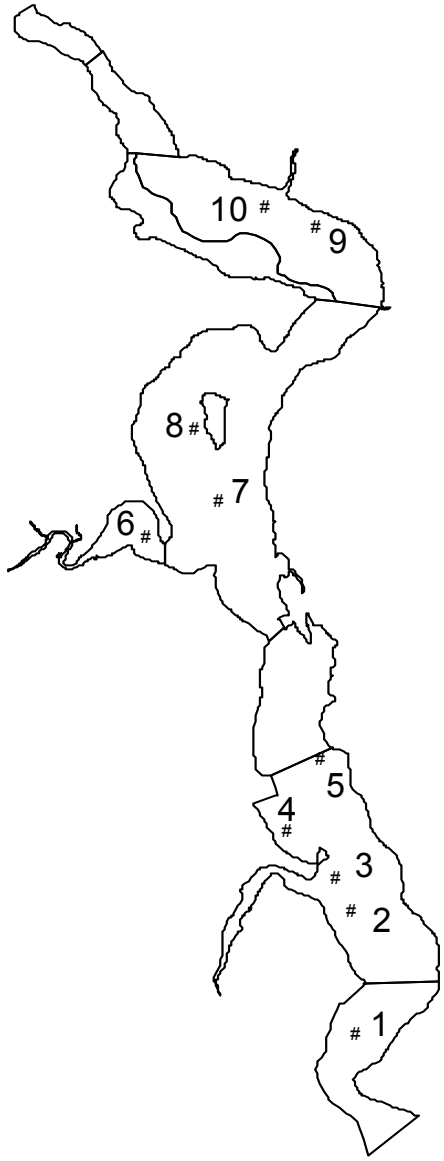
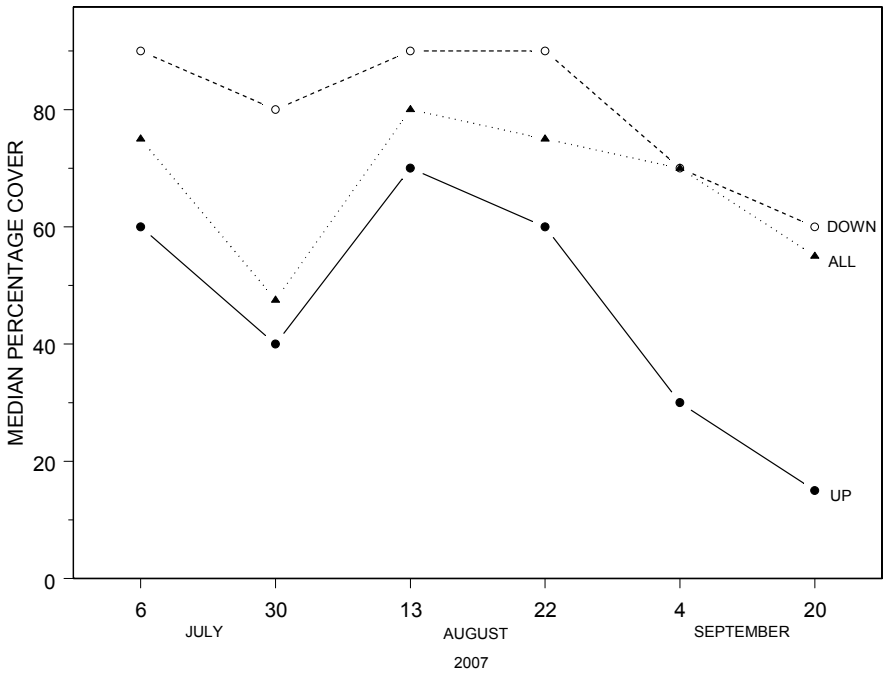


Figure 8. *The sites on the Ythan estuary where samples of green algae were collected in 2007. The numbers refer to the sites named in Appendix 3. There were no algal mats in the two upstream sections.*



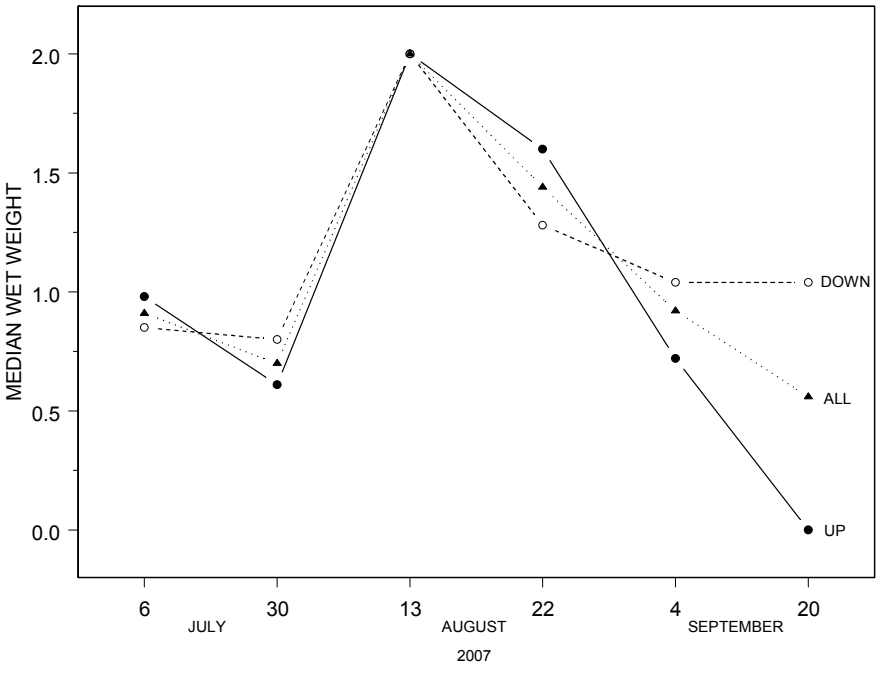


Figure 9. *The median percentage cover and median wet weight (kg per square metre) of green algae at downstream sites (downstream of Waterside Bridge), upstream sites and over all sites, in summer 2007.*

8. APPENDICES

APPENDIX 1. The number of birds of each species in each section of the Ythan estuary on each count date in 2006/07.

As in previous reports, the data are presented in separate species accounts, arranged in taxonomic order (as recently revised by the British Ornithologists' Union). For each species, a table shows the number of birds found in each section of the estuary from the mouth upstream (ie, Mouth, Inches, Quay, Tarty, Sleek, Haddo, Snub, Machar, and Logie), as defined in Figure 1, and the total on the whole estuary, on each count date. Information which is not obvious from the data tables is appended and peak numbers of the commoner species are compared with those in the previous year.

MUTE SWAN *Cygnus olor*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	0	0	0	0	10	1	0	0	0	11
21 7 2006	0	0	0	0	0	0	6	0	0	6
5 8 2006	0	0	0	0	0	0	6	0	0	6
25 9 2006	0	0	0	0	3	0	0	4	0	7
8 10 2006	0	0	0	0	0	0	3	0	0	3
23 10 2006	0	3	0	0	5	0	0	0	0	8
12 11 2006	0	0	0	1	14	18	3	0	0	36
25 11 2006	0	0	0	3	21	5	0	0	0	29
12 12 2006	0	0	0	7	7	7	0	0	0	21
24 12 2006	0	0	0	0	45	2	0	0	0	47
4 1 2007	0	0	0	0	42	3	0	0	0	45
23 1 2007	0	0	0	0	35	1	2	0	0	38
6 2 2007	0	0	0	0	20	0	0	0	0	20
19 2 2007	0	0	0	0	24	3	0	0	2	29
7 3 2007	0	0	0	0	16	0	0	0	0	16
23 3 2007	0	0	0	0	51	1	0	0	0	52
7 4 2007	0	0	2	1	13	2	1	0	0	19
21 4 2007	0	5	0	0	3	8	0	0	0	16
12 5 2007	0	4	0	0	2	1	2	0	0	9
27 5 2007	0	0	0	1	2	2	20	0	0	25
6 6 2007	0	0	0	0	10	4	21	0	0	35
23 6 2007	0	1	0	0	17	2	6	0	0	26

Peak; 52: (2005/06 peak; 51)

WHOOPER SWAN *Cygnus cygnus*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
12 11 2006	0	0	0	0	2	1	0	0	0	3
12 12 2006	0	0	0	0	24	0	0	0	0	24
23 6 2007	0	0	0	0	0	0	1	0	0	1

PINK-FOOTED GOOSE *Anser brachyrhychus*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 3 2007	0	0	0	0	9	0	0	0	0	9
12 5 2007	0	0	0	0	0	92	6	0	0	98

GREYLAG GOOSE *Anser anser*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
12 5 2007	0	0	0	0	0	3	0	0	0	3

BARNACLE GOOSE Branta leucopsis

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
12 5 2007	0	0	0	0	0	1	0	0	0	1

BRENT GOOSE Branta bernicla

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
25 11 2006	2	0	0	0	0	0	0	0	0	2
12 12 2006	2	0	0	0	0	0	0	0	0	2
21 4 2007	1	0	0	0	0	0	0	0	0	1

COMMON SHELDUCK *Tadorna tadorna*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	0	6	0	0	23	29	2	0	2	62
21 7 2006	0	1	0	0	14	11	5	0	0	31
5 8 2006	0	0	0	0	17	20	0	0	0	37
13 8 2006	0	0	0	0	5	2	12	2	0	21
2 9 2006	0	0	0	0	1	2	0	0	0	3
25 9 2006	0	0	0	0	0	2	0	0	0	2
12 11 2006	0	0	0	0	0	14	0	0	0	14
25 11 2006	0	0	0	0	0	16	0	0	0	16
12 12 2006	0	15	0	0	20	5	0	0	0	40
24 12 2006	0	0	0	0	3	36	0	0	0	39
4 1 2007	0	0	0	0	0	65	0	3	0	68
23 1 2007	0	0	0	0	52	4	0	2	3	61
6 2 2007	0	4	0	2	70	7	3	4	0	90
19 2 2007	0	20	1	0	106	5	0	6	1	139
7 3 2007	2	21	8	8	91	20	80	2	0	232
23 3 2007	2	15	0	0	63	44	0	0	0	124
7 4 2007	0	9	3	0	46	35	13	4	0	110
21 4 2007	1	8	5	3	12	25	5	0	2	61
12 5 2007	0	12	6	6	113	33	3	4	20	197
27 5 2007	0	6	6	3	51	51	23	5	1	146
6 6 2007	0	8	2	0	23	28	12	0	4	77
23 6 2007	0	6	1	6	52	63	3	0	0	131

Peak; 232: (2005/06 peak; 153)

EURASIAN WIGEON *Anas penelope*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	0	0	0	0	0	2	0	0	0	2
13 8 2006	0	3	0	0	0	0	0	0	0	3
2 9 2006	0	1	0	0	0	0	14	0	0	15
25 9 2006	0	0	0	0	7	0	3	0	0	10
8 10 2006	0	0	57	0	0	0	0	0	0	57
23 10 2006	0	6	60	0	0	0	3	0	0	69
12 11 2006	18	26	35	0	520	0	50	0	0	649
25 11 2006	20	33	98	0	285	0	0	0	0	436
12 12 2006	5	120	28	0	27	0	0	0	0	180
24 12 2006	5	86	34	0	282	0	0	0	0	407
4 1 2007	7	38	98	0	2	0	0	0	0	145
23 1 2007	8	32	176	0	44	0	0	0	0	260
6 2 2007	41	40	5	0	166	0	10	0	0	262
19 2 2007	0	57	6	0	202	0	0	0	0	265
7 3 2007	0	49	12	0	102	0	34	0	0	197
23 3 2007	0	32	10	0	61	0	0	0	0	103
7 4 2007	0	5	2	0	17	0	25	0	0	49
21 4 2007	0	0	0	0	36	0	0	0	0	36
27 5 2007	0	0	0	0	1	0	0	0	0	1
6 6 2007	0	0	0	0	0	2	0	0	0	2
23 6 2007	0	0	0	0	0	5	9	0	0	14

Peak; 649: (2005/06 peak; 667)

EURASIAN TEAL *Anas crecca*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
2 9 2006	0	0	0	0	0	0	60	0	0	60
12 11 2006	0	0	0	0	0	0	0	0	16	16
25 11 2006	0	0	0	0	50	0	0	0	0	50
24 12 2006	0	0	0	0	10	0	0	0	0	10
6 2 2007	0	0	0	0	0	0	40	5	0	45
23 3 2007	0	0	0	0	0	0	0	4	12	16
7 4 2007	0	0	0	0	0	0	0	2	9	11
21 4 2007	0	0	0	0	0	0	0	0	8	8

Peak; 60: (2005/06 peak; 135)

MALLARD *Anas platyrhynchos*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
21 7 2006	0	5	0	0	0	0	0	0	0	5
5 8 2006	0	0	0	0	0	0	0	0	2	2
2 9 2006	0	0	0	0	0	0	38	0	0	38
25 9 2006	0	13	0	3	0	0	0	0	0	16
8 10 2006	0	5	0	0	0	0	0	0	0	5
23 10 2006	0	10	4	0	0	0	0	0	1	15
12 11 2006	0	7	0	0	0	0	0	0	0	7
25 11 2006	0	15	0	0	0	0	5	0	0	20
12 12 2006	0	22	0	0	0	0	0	0	0	22
24 12 2006	0	48	2	0	36	110	0	0	0	196
4 1 2007	0	4	0	0	0	0	0	0	0	4
23 1 2007	0	8	11	0	0	0	0	10	0	29
6 2 2007	0	13	0	0	35	0	0	0	0	48
19 2 2007	0	18	1	0	0	0	0	0	0	19
7 3 2007	0	8	1	0	0	0	0	2	4	15
23 3 2007	0	13	2	0	2	4	0	7	0	28
7 4 2007	0	0	0	0	0	0	6	1	2	9
21 4 2007	3	5	0	0	0	2	16	0	0	26
12 5 2007	0	1	2	2	0	0	9	0	2	16
27 5 2007	0	9	0	0	2	2	5	0	0	18
6 6 2007	0	0	0	0	1	4	7	0	0	12
23 6 2007	0	1	0	0	2	7	0	0	0	10

Peak; 196: (2005/06 peak; 69)

NORTHERN PINTAIL *Anas acuta*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
2 9 2006	0	0	0	0	0	2	0	0	0	2
24 12 2006	0	0	0	0	2	0	0	0	0	2
7 3 2007	0	0	0	0	2	0	0	0	0	2
21 4 2007	0	0	0	0	0	0	4	0	0	4

TUFTED DUCK *Aythya fuligula*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
23 10 2006	0	1	0	0	0	0	0	0	0	1
12 11 2006	0	1	0	0	0	0	0	0	0	1
24 12 2006	0	4	0	0	0	0	0	0	0	4
23 1 2007	0	3	0	0	0	0	0	0	0	3

GREATER SCAUP *Aythya marila*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
25 11 2006	0	8	0	0	0	0	0	0	0	8
12 12 2006	0	6	0	0	0	0	0	0	0	6

COMMON EIDER *Somateria mollissima*

Date	Mo	In	Qu	Sl	Ha	Total
7 7 2006	1069	55	34	4	0	1162
21 7 2006	1366	2	0	13	0	1381
8 8 2006	167	2	3	4	0	176
21 8 2006	428	27	7	8	0	470
6 9 2006	421	23	0	2	0	446
19 9 2006	712	11	4	1	0	728
4 10 2006	417	72	896	0	0	1385
22 10 2006	67	0	241	10	0	318
9 11 2006	20	279	548	18	0	865
20 11 2006	24	910	7	5	0	946
5 12 2006	7	761	24	116	0	908
19 12 2006	6	4	587	74	0	671
5 1 2007	1	4	509	65	0	579
16 1 2007	18	312	178	20	0	528
1 2 2007	5	18	429	18	0	470
13 2 2007	164	285	25	5	0	479
1 3 2007	43	181	191	54	0	469
21 3 2007	22	82	228	71	0	403
12 4 2007	574	183	35	51	0	843
27 4 2007	977	572	165	131	0	1845
8 5 2007	1503	687	240	54	0	2484
15 5 2007	1384	959	269	54	10	2676
21 5 2007	1382	973	190	44	4	2593
28 5 2007	1405	847	167	42	9	2470
4 6 2007	901	360	50	27	0	1338
19 6 2007	746	199	67	37	4	1053

Peak; 2,676: (2005/06 peak; 4,006)

No Eiders were seen at Snub, Machar or Logie

The total number of ducklings reared in 2007 was 18, including one on the sea coast between Collieston and the mouth of the estuary.

LONG-TAILED DUCK *Clangula hyemalis*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
12 11 2006	0	0	0	0	0	0	1	0	0	1
7 4 2007	0	2	0	0	0	0	0	0	0	2
21 4 2007	0	2	0	0	0	0	0	0	0	2
23 6 2007	0	1	0	0	0	0	0	0	0	1

GOLDENEYE *Bucephala clangula*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
13 8 2006	0	0	0	0	0	0	3	0	0	3
2 9 2006	0	0	0	0	0	0	6	0	0	6
12 11 2006	0	0	0	0	5	2	3	0	4	14
25 11 2006	0	4	0	0	3	0	3	0	0	10
12 12 2006	0	2	1	0	2	1	0	0	5	11
24 12 2006	2	14	0	0	10	0	0	1	0	27
4 1 2007	1	1	0	0	1	0	1	0	0	4
23 1 2007	0	6	1	0	6	0	2	4	2	21
6 2 2007	1	1	2	0	2	0	8	5	0	19
19 2 2007	0	1	1	0	4	2	0	0	2	10
7 3 2007	0	0	2	0	4	6	0	0	0	12
23 3 2007	0	0	3	0	15	3	0	0	0	21
7 4 2007	0	0	0	0	16	0	4	0	0	20
21 4 2007	0	0	0	0	1	4	2	6	1	14
12 5 2007	0	0	0	0	0	0	8	0	0	8
6 6 2007	0	0	0	0	0	0	0	0	4	4

Peak; 27: (2005/06 peak; 35)

RED-BREASTED MERGANSER *Mergus serrator*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
13 8 2006	0	0	1	0	0	0	0	0	0	1
2 9 2006	2	0	0	0	0	0	0	0	0	2
25 9 2006	0	5	0	0	0	0	0	0	0	5
8 10 2006	2	4	2	0	0	0	0	0	0	8
23 10 2006	4	0	6	0	0	0	2	0	0	12
12 11 2006	1	9	2	0	18	1	2	0	0	33
25 11 2006	0	6	1	0	5	0	0	0	0	12
12 12 2006	2	3	2	0	4	0	0	0	0	11
24 12 2006	1	6	1	0	3	0	0	0	0	11
4 1 2007	2	9	0	0	0	0	0	0	1	12
23 1 2007	3	4	3	0	4	0	0	0	0	14
6 2 2007	3	1	1	0	0	0	0	0	0	5
19 2 2007	0	6	2	0	4	0	0	0	0	12
7 3 2007	0	2	1	0	5	2	0	0	1	11
23 3 2007	4	0	3	0	4	0	0	0	0	11
7 4 2007	0	5	3	0	8	0	0	0	0	16
21 4 2007	4	4	0	0	9	0	0	0	0	17
12 5 2007	2	0	0	0	6	0	0	0	0	8

Peak; 33: (2005/06 peak; 24)

RED-THROATED DIVER *Gavia stellata*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
25 9 2006	1	0	0	0	0	0	0	0	0	1
25 11 2006	0	1	0	0	0	0	0	0	0	1
24 12 2006	0	0	1	0	0	0	0	0	0	1

LITTLE GREBE *Podiceps ruficollis*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
23 10 2006	0	0	0	0	0	0	0	0	3	3
25 11 2006	0	0	0	1	0	0	0	0	0	1
6 2 2007	0	0	0	0	0	0	0	0	1	1
19 2 2007	0	0	0	0	0	0	0	0	1	1

GREAT CORMORANT *Phalacrocorax carbo*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	1	0	0	0	1	0	15	0	0	17
21 7 2006	0	1	0	0	0	0	6	0	0	7
5 8 2006	1	2	0	0	6	14	2	4	0	29
13 8 2006	12	8	2	0	30	0	3	2	4	61
2 9 2006	0	4	5	0	27	0	36	0	1	73
25 9 2006	2	3	1	0	23	4	2	1	1	37
8 10 2006	0	11	3	0	19	5	5	0	0	43
23 10 2006	2	2	1	0	6	5	0	0	0	16
12 11 2006	1	0	1	0	4	2	2	0	0	10
25 11 2006	2	2	0	0	2	9	0	0	0	15
12 12 2006	1	2	1	0	2	0	0	0	0	6
24 12 2006	0	0	0	0	5	0	3	0	0	8
4 1 2007	0	1	0	0	0	2	1	2	1	7
23 1 2007	0	1	1	0	2	0	3	0	0	7
6 2 2007	0	1	0	0	0	0	0	0	0	1
19 2 2007	0	6	1	0	0	0	0	1	0	8
7 3 2007	1	1	0	0	1	0	0	2	0	5
23 3 2007	3	0	0	0	2	1	0	0	0	6
7 4 2007	0	0	1	0	4	0	0	3	1	9
21 4 2007	0	0	1	0	1	1	2	0	0	5
12 5 2007	0	2	0	0	0	6	5	0	0	13
27 5 2007	0	3	0	0	2	0	0	0	0	5
6 6 2007	1	0	0	0	5	0	0	0	0	6
23 6 2007	0	1	1	0	1	0	8	0	0	11

Peak; 73: (2005/06 peak; 50)

GREY HERON *Ardea cinerea*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	0	0	0	0	31	0	0	0	0	31
21 7 2006	0	2	4	0	20	4	3	0	1	34
5 8 2006	0	0	0	0	2	1	30	0	1	34
13 8 2006	6	7	5	0	12	2	1	0	1	34
2 9 2006	3	10	3	0	16	0	20	2	1	55
25 9 2006	5	6	2	1	8	2	3	0	1	28
8 10 2006	5	5	3	0	8	1	5	0	0	27
23 10 2006	4	11	3	1	9	2	3	2	0	35
12 11 2006	1	0	2	1	5	1	0	0	0	10
25 11 2006	2	3	1	2	3	1	1	0	1	14
12 12 2006	0	1	0	0	4	1	0	0	1	7
24 12 2006	0	10	1	2	2	0	0	0	0	15
4 1 2007	1	1	0	0	0	0	0	0	0	2
23 1 2007	2	4	0	0	1	0	0	0	0	7
6 2 2007	1	1	0	0	1	0	0	0	0	3
19 2 2007	0	2	0	0	1	0	0	0	1	4
7 3 2007	0	0	1	0	5	0	0	0	0	6
23 3 2007	0	0	0	0	6	2	0	0	0	8
7 4 2007	1	2	1	1	3	0	0	0	0	8
21 4 2007	0	1	0	1	2	0	0	0	0	4
12 5 2007	2	3	0	0	3	0	0	0	0	8
27 5 2007	1	1	0	0	3	0	0	0	0	5
6 6 2007	4	2	5	3	12	0	0	0	0	26
23 6 2007	0	5	2	3	7	0	0	0	1	18

Peak; 55: (2005/06 peak; 35)

OSPREY *Pandion haliaetus*

21 7 2006	0	1	0	0	0	0	0	0	0	1
5 8 2006	0	0	0	1	0	0	0	0	0	1
2 9 2006	0	0	0	0	3	0	0	0	0	3
12 5 2007	0	0	0	0	0	0	3	0	0	3
27 5 2007	0	0	0	0	1	0	0	0	0	1

OYSTERCATCHER *Haematopus ostralegus*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	17	28	4	8	8	9	0	2	2	78
21 7 2006	28	131	29	4	38	12	1	10	1	254
5 8 2006	372	210	29	1	29	0	3	0	0	644
13 8 2006	134	166	8	4	10	0	1	0	0	323
2 9 2006	118	378	31	4	28	0	0	0	0	559
25 9 2006	158	208	14	0	9	0	0	0	0	389
8 10 2006	146	174	16	2	21	3	2	0	0	364
23 10 2006	152	90	16	2	44	3	0	0	0	307
12 11 2006	177	153	22	4	15	2	0	0	0	373
25 11 2006	61	170	31	7	35	6	0	0	0	310
12 12 2006	89	194	23	7	22	8	0	0	0	343
24 12 2006	83	113	50	7	37	2	0	0	0	292
4 1 2007	210	156	33	1	6	1	0	0	0	407
23 1 2007	95	112	31	5	32	0	2	0	0	277
6 2 2007	85	128	24	5	36	0	0	0	0	278
19 2 2007	207	120	18	0	75	0	13	11	0	444
7 3 2007	156	43	9	22	45	4	54	12	2	347
23 3 2007	87	80	11	11	53	6	30	8	0	286
7 4 2007	24	70	10	2	25	6	41	0	0	178
21 4 2007	29	88	26	3	27	2	4	0	1	180
12 5 2007	12	60	7	1	50	2	57	1	0	190
27 5 2007	14	52	6	11	12	1	6	2	1	105
6 6 2007	12	52	12	5	30	0	2	0	0	113
23 6 2007	20	72	17	19	31	4	0	0	0	163

Peak; 644: (2005/06 peak; 655)

RINGED PLOVER *Charadrius hiaticula*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
21 7 2006	4	0	0	0	0	0	0	0	0	4
5 8 2006	1	0	21	0	0	0	0	0	0	22
2 9 2006	14	0	0	0	0	6	0	0	0	20
23 10 2006	0	0	0	0	9	0	0	0	0	9
12 12 2006	0	3	0	0	0	0	0	0	0	3
24 12 2006	0	0	0	0	3	10	0	0	0	13
23 1 2007	0	0	0	0	0	0	2	0	0	2
6 2 2007	0	0	0	0	0	4	6	0	0	10
19 2 2007	0	0	0	0	9	0	0	0	0	9
7 3 2007	0	2	0	0	8	0	0	0	0	10
23 3 2007	0	0	0	0	11	0	0	0	0	11
7 4 2007	2	3	0	0	0	0	0	0	0	5
21 4 2007	0	54	0	0	0	0	0	0	0	54
12 5 2007	13	0	0	0	0	0	0	0	0	13
27 5 2007	0	9	0	0	0	0	0	0	0	9
6 6 2007	19	0	0	0	0	0	0	0	0	19

Peak; 54: (2005/06 peak; 79)

EUROPEAN GOLDEN PLOVER *Pluvialis apricaria*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	0	1	0	0	0	0	0	0	0	1
21 7 2006	0	240	0	0	0	0	0	0	0	240
5 8 2006	0	231	125	0	0	0	0	0	0	356
13 8 2006	0	6	0	0	0	0	0	0	0	6
2 9 2006	0	94	0	0	1600	0	0	0	0	1694
25 9 2006	0	1400	1	0	450	1800	0	0	0	3651
8 10 2006	0	2500	0	0	0	0	0	0	0	2500
23 10 2006	0	2500	0	0	0	1200	0	0	0	3700
12 11 2006	0	775	0	0	0	1800	0	0	0	2575
25 11 2006	0	11	0	0	0	650	0	0	0	661
12 12 2006	0	450	0	0	0	210	0	0	0	660
24 12 2006	0	80	0	0	0	40	0	0	0	120
4 1 2007	0	76	0	0	0	0	0	0	0	76
23 1 2007	0	760	0	0	0	0	120	0	0	880
6 2 2007	0	0	230	0	0	0	430	0	0	660
19 2 2007	0	0	0	0	0	310	0	0	0	310
7 3 2007	0	0	0	0	0	230	0	0	0	230

Peak; 3,700: (2005/06 peak; 3,540)

GREY PLOVER *Pluvialis squatarola*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
25 9 2006	0	2	0	0	0	0	0	0	0	2
12 11 2006	0	1	0	0	0	0	0	0	0	1
25 11 2006	0	2	0	0	0	0	0	0	0	2
12 12 2006	4	2	0	0	0	0	0	0	0	6
24 12 2006	1	5	0	0	0	0	0	0	0	6
4 1 2007	0	5	0	0	0	0	0	0	0	5
23 1 2007	1	4	0	0	0	0	0	0	0	5
6 2 2007	1	6	0	0	0	0	0	0	0	7
19 2 2007	0	3	0	0	0	0	0	0	0	3
7 3 2007	0	2	0	0	0	0	0	0	0	2

NORTHERN LAPWING *Vanellus vanellus*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	0	0	45	0	216	295	151	8	2	717
21 7 2006	0	40	15	100	128	640	90	7	120	1140
5 8 2006	0	0	204	15	687	140	870	15	60	1991
13 8 2006	0	22	0	0	101	20	4	11	0	158
2 9 2006	0	64	195	90	1179	900	286	0	0	2714
25 9 2006	0	190	328	60	2835	1040	340	47	0	4840
8 10 2006	0	275	20	80	940	450	650	50	0	2465
23 10 2006	0	169	232	80	1170	524	700	0	0	2875
12 11 2006	0	172	43	50	465	1180	410	0	0	2320
25 11 2006	0	130	2	0	1481	730	260	0	0	2603
12 12 2006	0	200	70	70	605	382	163	80	0	1570
24 12 2006	0	57	5	0	48	20	2	0	0	132
4 1 2007	0	12	0	0	0	11	25	0	0	48
23 1 2007	2	6	8	2	17	27	36	0	0	98
6 2 2007	0	25	25	3	27	159	45	0	0	284
19 2 2007	0	0	22	0	790	820	200	20	0	1852
7 3 2007	0	0	1	0	440	90	120	40	0	691
23 3 2007	0	0	0	0	8	0	80	2	0	90
7 4 2007	0	1	0	0	0	52	0	0	0	53
12 5 2007	0	0	1	0	1	2	0	0	0	4
27 5 2007	0	0	0	0	1	0	0	6	0	7
6 6 2007	0	0	0	2	0	22	0	25	2	51
23 6 2007	0	2	0	0	52	58	330	0	3	445

Peak; 4,840: (2005/06 peak; 6,596)

RED KNOT *Calidris canutus*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
21 7 2006	0	25	0	0	25	0	0	0	0	50
5 8 2006	5	0	0	0	0	0	0	0	0	5
2 9 2006	0	1	0	0	50	0	0	0	0	51
25 9 2006	0	2	0	0	0	2	0	0	0	4
8 10 2006	0	0	5	0	15	0	0	0	0	20
23 10 2006	0	0	0	0	0	60	0	0	0	60
12 11 2006	0	65	0	0	0	0	0	0	0	65
25 11 2006	0	0	0	0	0	26	0	0	0	26
24 12 2006	0	100	0	0	0	30	0	0	0	130
23 1 2007	0	0	0	0	0	120	0	0	0	120
6 2 2007	0	0	0	0	0	110	0	0	0	110
19 2 2007	0	0	40	0	70	0	0	0	0	110
7 3 2007	0	0	0	0	80	0	0	0	0	80
23 3 2007	0	0	0	0	0	50	0	0	0	50

Peak; 130: (2005/06 peak; 460)

DUNLIN *Calidris alpina*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	0	0	0	0	0	0	4	0	0	4
21 7 2006	0	0	0	0	21	0	1	0	0	22
5 8 2006	1	0	1	0	0	0	2	0	0	4
13 8 2006	0	0	0	0	0	0	0	21	0	21
2 9 2006	0	0	0	0	5	165	55	0	0	225
25 9 2006	0	8	0	0	1	159	0	250	0	418
8 10 2006	0	0	0	0	14	30	270	8	0	322
23 10 2006	0	0	0	0	0	360	100	120	0	580
12 11 2006	0	0	0	0	0	156	0	0	0	156
25 11 2006	0	4	0	0	5	54	0	0	0	63
12 12 2006	0	5	0	0	21	220	12	6	0	264
24 12 2006	0	3	0	0	2	182	2	0	0	189
4 1 2007	0	1	0	0	0	60	80	36	0	177
23 1 2007	0	0	0	0	0	152	50	0	0	202
6 2 2007	0	0	0	0	0	260	0	0	0	260
19 2 2007	0	0	0	0	8	210	130	0	0	348
7 3 2007	0	0	0	0	0	0	40	0	0	40
23 3 2007	0	0	0	0	0	40	0	0	0	40
21 4 2007	0	0	0	0	2	5	0	0	0	7
27 5 2007	0	0	0	0	1	0	0	2	0	3
6 6 2007	17	0	0	0	0	0	0	0	0	17

Peak; 580: (2005/06 peak; 1,242)

RUFF *Philomachus pugnax*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
25 9 2006	0	0	0	0	0	2	0	5	0	7
4 1 2007	0	0	0	0	0	0	0	0	0	0

SNIPE *Gallinago gallinago*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
23 10 2006	0	0	0	0	0	0	0	0	1	1

BLACK-TAILED GODWIT *Limosa limosa*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
21 7 2006	0	6	0	0	0	0	0	0	0	6
5 8 2006	2	3	0	0	0	0	0	0	0	5
13 8 2006	0	0	0	0	2	0	0	0	0	2
8 10 2006	0	1	3	0	0	0	0	0	0	4
21 4 2007	0	0	0	0	3	0	0	0	0	3
12 5 2007	0	1	0	0	1	0	0	0	0	2
6 6 2007	0	0	0	0	0	0	0	5	0	5

BAR-TAILED GODWIT *Limosa lapponica*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	0	0	0	0	1	0	0	0	0	1
21 7 2006	0	7	0	0	1	0	0	0	0	8
5 8 2006	16	10	0	0	0	0	0	0	0	26
13 8 2006	0	1	7	0	0	0	0	0	0	8
2 9 2006	0	12	4	0	11	0	0	0	0	27
25 9 2006	0	7	2	0	2	1	0	0	0	12
8 10 2006	0	9	20	0	3	0	0	0	0	32
23 10 2006	1	3	16	0	5	0	0	0	0	25
12 11 2006	10	27	5	0	0	0	0	0	0	42
25 11 2006	2	21	2	0	13	0	0	0	0	38
12 12 2006	2	19	1	0	7	0	1	0	0	30
24 12 2006	4	4	14	0	25	0	0	0	0	47
4 1 2007	2	8	6	0	0	0	0	0	0	16
23 1 2007	3	4	14	0	3	0	0	0	0	24
6 2 2007	0	16	8	0	3	1	0	0	0	28
19 2 2007	1	1	8	0	3	0	0	0	0	13
7 3 2007	1	1	2	0	24	0	1	0	0	29
23 3 2007	0	4	0	0	15	0	0	0	0	19
7 4 2007	0	1	0	0	29	0	0	0	0	30
21 4 2007	0	2	2	2	5	0	0	0	0	11
12 5 2007	0	15	0	0	0	0	0	0	0	15
27 5 2007	0	0	1	0	0	0	0	0	0	1

Peak; 47: (2005/06 peak; 57)

WHIMBREL *Numenius phaeopus*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
12 5 2007	0	0	0	0	0	0	2	0	0	2
27 5 2007	0	0	0	0	0	1	0	0	0	1

EURASIAN CURLEW *Numenius arquata*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	0	14	15	0	111	90	1	2	0	233
21 7 2006	1	163	3	50	350	765	6	0	0	1338
5 8 2006	0	117	1	1	2563	256	12	1	0	2951
13 8 2006	6	88	7	4	27	35	13	3	0	183
2 9 2006	3	139	10	1	400	75	48	0	0	676
25 9 2006	3	85	6	10	57	60	7	2	1	231
8 10 2006	6	74	8	24	375	41	11	2	1	542
23 10 2006	4	51	9	17	451	55	27	3	1	618
12 11 2006	44	58	8	3	94	23	8	0	0	238
25 11 2006	1	42	3	31	15	2	4	0	1	99
12 12 2006	0	66	5	0	8	7	9	0	1	96
24 12 2006	7	80	14	3	73	36	6	0	0	219
4 1 2007	0	60	1	120	141	182	21	0	1	526
23 1 2007	5	60	6	8	36	28	3	0	1	147
6 2 2007	10	86	5	5	461	287	65	0	1	920
19 2 2007	39	51	7	40	134	90	12	90	0	463
7 3 2007	4	90	10	7	1411	82	8	46	3	1661
23 3 2007	1	9	4	15	24	172	8	5	0	238
7 4 2007	2	28	4	1	42	9	2	0	0	88
21 4 2007	0	10	3	0	24	7	3	0	0	47
12 5 2007	0	97	0	0	41	2	1	0	0	141
27 5 2007	1	50	2	2	28	27	4	0	0	114
6 6 2007	1	5	0	0	49	7	9	0	0	71
23 6 2007	0	25	11	4	122	20	17	0	0	199

Peak; 2,951: (2005/06 peak; 827)

COMMON REDSHANK *Tringa totanus*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	0	5	2	0	112	24	34	23	0	200
21 7 2006	0	12	81	11	318	95	67	4	0	588
5 8 2006	0	90	155	1	489	51	9	0	31	826
13 8 2006	9	127	37	12	53	119	56	193	4	610
2 9 2006	7	155	40	8	295	319	233	29	0	1086
25 9 2006	19	76	23	19	143	479	149	8	1	917
8 10 2006	16	121	33	42	288	320	89	76	0	985
23 10 2006	6	48	32	24	200	290	126	19	10	755
12 11 2006	17	75	12	8	61	178	40	4	2	397
25 11 2006	0	71	0	19	62	157	53	6	1	369
12 12 2006	1	62	1	76	288	88	45	2	1	564
24 12 2006	7	59	19	44	192	117	54	4	1	497
4 1 2007	1	22	2	0	5	30	16	50	1	127
23 1 2007	2	20	1	37	169	92	46	12	0	379
6 2 2007	0	18	6	36	269	73	84	5	1	492
19 2 2007	4	26	2	22	162	219	140	5	0	580
7 3 2007	0	33	32	89	94	237	215	3	1	704
23 3 2007	2	9	6	38	25	475	219	18	1	793
7 4 2007	0	36	19	2	132	513	182	72	1	957
21 4 2007	5	104	27	129	257	217	116	4	0	859
12 5 2007	0	0	0	0	0	0	7	3	3	13
27 5 2007	0	0	0	0	0	0	11	5	0	16
6 6 2007	0	0	0	0	0	1	6	15	0	22
23 6 2007	0	0	0	0	0	2	3	13	1	19

Peak; 1,086: (2005/06 peak; 1,476)

COMMON GREENSHANK *Tringa nebularia*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
7 7 2006	0	0	0	0	1	0	0	0	0	1
21 7 2006	0	0	0	0	1	0	1	1	0	3
5 8 2006	0	0	0	2	7	3	0	0	0	12
13 8 2006	0	0	0	4	1	1	0	0	0	6
2 9 2006	0	0	0	2	2	3	1	1	1	10
25 9 2006	0	0	0	1	0	0	0	0	0	1
8 10 2006	0	0	0	0	0	1	0	0	0	1
25 11 2006	0	0	0	0	1	0	0	0	0	1
21 4 2007	0	0	0	0	1	0	0	0	0	1
12 5 2007	0	0	0	0	0	1	0	0	0	1
27 5 2007	0	0	0	0	0	1	0	0	0	1
6 6 2007	0	0	0	0	1	0	0	0	0	1

COMMON SANDPIPER *Actitis hypoleucos*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
21 7 2006	0	0	0	0	0	0	0	0	1	1

RUDDY TURNSTONE *Arenaria interpres*

Date	Mo	In	Qu	Ta	Sl	Ha	Sn	Ma	Lo	Total
2 9 2006	2	0	0	0	0	0	0	0	0	2
25 9 2006	15	0	0	0	0	0	0	0	0	15
8 10 2006	8	7	1	0	0	0	0	0	0	16
23 10 2006	1	4	0	0	0	0	0	0	0	5
12 11 2006	8	37	0	0	0	0	1	0	0	46
25 11 2006	10	26	0	0	0	2	0	0	22	60
12 12 2006	4	12	0	0	1	0	0	0	0	17
24 12 2006	7	11	0	0	4	0	0	0	0	22
4 1 2007	0	7	0	0	0	0	0	0	0	7
23 1 2007	2	10	8	0	0	0	0	0	0	20
6 2 2007	1	12	0	0	0	0	0	0	0	13
19 2 2007	3	2	0	0	1	0	0	0	0	6
7 3 2007	0	7	1	0	0	0	0	0	0	8
23 3 2007	0	2	0	0	0	1	0	0	0	3
7 4 2007	1	0	0	0	0	0	0	0	0	1
21 4 2007	0	9	0	0	0	0	0	0	0	9

Peak; 60: (2005/06 peak; 51)

APPENDIX 2

Table 1. *The sub-sections of the Ythan estuary and the area of each.*

Sub-section	Area(ha)
MO1W	3.2923
MO1E	1.9681
MO2W	7.3799
MO2E	2.8838
IN1W	10.6650
IN1E	4.2135
IN2W	12.4207
IN2E	1.2733
IN3W	5.5024
IN3E	7.2483
QU1W	3.9751
QU1E	2.7631
QU2W	1.9818
QU2E	5.8719
TA1	7.0329
SL1W	7.1739
SL1E	4.7832
SL2W	18.6217
SL2E	1.7148
SL3W	11.2433
SL3E	2.4216
SL4W	10.0400
SL4E	1.7751
SL5W	3.0076
SL5E	2.3540
HA1	15.0968
HA2	11.3584
HA3	7.6713
SN1	5.3940
SN2	6.4612
SN3	4.5350
MA1W	3.0060
MA1E	2.6229
LO1W	1.6673
LO1E	1.3551
Mean	5.7364
Median	4.5350
Maximum	18.6217
Minimum	1.2733

Table 2. *Mean number of waterfowl in each sub-section of the Ythan estuary; September to March 2006/07. The species codes are: MS – Mute Swan; SU – Shelduck; WG – Wigeon; MA – Mallard; RM – Red-breasted Merganser; CA – Cormorant; H. – Heron.*

	Species						
Section	MS	SU	WG	MA	RM	CA	H.
MO1W	0.00	0.00	0.00	0.00	0.07	0.21	0.14
MO1E	0.00	0.00	0.00	0.00	0.07	0.00	0.00
MO2W	0.00	0.00	3.14	0.00	0.57	0.36	0.43
MO2E	0.00	0.29	4.29	0.00	1.00	0.29	1.14
IN1W	0.00	1.93	1.93	0.21	0.50	0.36	0.57
IN1E	0.00	0.14	4.00	0.00	0.79	0.50	0.43
IN2W	0.00	2.43	12.64	12.21	0.79	0.79	1.29
IN2E	0.00	0.14	0.21	0.00	0.14	0.29	0.07
IN3W	0.23	0.29	14.29	0.71	0.93	0.21	0.71
IN3E	0.00	0.43	4.07	0.00	0.79	0.29	0.79
QU1W	0.00	0.00	0.36	0.00	0.14	0.14	0.29
QU1E	0.00	0.14	14.71	0.00	0.21	0.50	0.29
QU2W	0.00	0.07	2.00	0.86	0.50	0.00	0.14
QU2E	0.00	0.43	27.14	0.64	0.86	0.36	0.43
TA1	0.85	0.71	0.00	0.21	0.00	0.00	0.50
SL1W	0.69	1.86	9.00	0.36	1.36	0.93	0.57
SL1E	1.31	0.14	13.71	0.93	0.50	0.57	0.86
SL2W	4.77	13.79	14.21	0.00	0.00	2.93	0.43
SL2E	0.00	1.00	0.00	0.29	0.00	0.00	0.79
SL3W	7.77	7.36	61.14	0.21	0.14	1.50	0.64
SL3E	0.92	2.50	18.57	0.57	0.00	0.00	0.00
SL4W	0.00	0.71	2.79	0.00	0.50	0.36	0.14
SL4E	0.77	1.50	0.71	0.86	0.36	0.07	0.00
SL5W	2.69	0.00	1.14	2.00	0.43	0.21	0.64
SL5E	2.85	0.14	0.00	0.00	0.07	0.07	0.86
HA1	2.62	13.36	0.00	7.86	0.21	0.00	0.36
HA2	0.08	0.64	0.00	0.29	0.00	0.64	0.29
HA3	0.38	1.71	0.00	0.00	0.00	1.36	0.07
SN1	0.23	0.14	1.57	0.71	0.14	1.07	0.43
SN2	0.15	5.14	3.00	2.07	0.14	2.43	1.57
SN3	0.23	0.64	3.57	0.29	0.00	0.21	0.29
MA1W	0.00	0.79	0.00	0.79	0.00	0.21	0.14
MA1E	0.31	0.43	0.00	0.57	0.00	0.21	0.14
LO1W	0.15	0.29	0.00	0.00	0.00	0.00	0.14
LO1E	0.00	0.00	0.00	0.36	0.14	0.21	0.21

Table 3. *Mean number of waders in each sub-section of the Ythan estuary; September to March 2006/07. The species codes are: OC – Oystercatcher; GP – Golden Plover; L. – Lapwing; KN – Knot; DN – Dunlin; BA – Bar-tailed Godwit; CU – Curlew; RK – Redshank; TT – Turnstone.*

	Species								
Section	OC	GP	L.	KN	DN	BA	CU	RK	TT
MO1W	6.36	0.00	0.00	0.00	0.00	0.07	0.14	0.36	0.21
MO1E	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MO2W	56.14	0.00	0.00	0.00	0.00	1.00	1.79	3.71	3.21
MO2E	66.86	0.00	0.14	0.00	0.00	0.79	7.14	1.79	0.93
IN1W	60.36	0.00	0.29	0.00	0.64	4.50	13.71	11.07	4.50
IN1E	8.07	0.00	0.00	0.00	0.00	0.86	1.14	0.07	0.00
IN2W	41.21	3.15	6.79	0.00	0.00	0.64	34.29	12.79	2.71
IN2E	7.07	0.00	0.00	0.00	0.00	0.14	1.36	1.50	0.00
IN3W	4.79	3.08	74.43	13.83	0.86	2.07	3.43	23.71	0.14
IN3E	29.86	658.85	11.36	0.17	0.00	1.50	14.00	7.64	2.43
QU1W	1.43	0.00	8.14	0.00	0.00	3.07	1.00	3.79	0.57
QU1E	13.71	1.62	18.79	3.75	0.00	2.21	3.00	4.21	0.07
QU2W	1.71	0.00	12.93	0.00	0.00	0.79	1.36	1.14	0.00
QU2E	6.64	16.15	28.07	0.00	0.00	1.21	1.50	5.79	0.07
TA1	5.50	0.00	31.07	0.00	0.00	0.00	20.29	33.00	0.00
SL1W	2.93	0.00	64.86	12.50	0.07	0.29	1.14	13.79	0.14
SL1E	2.79	0.00	183.21	0.00	0.00	0.64	1.29	2.93	0.00
SL2W	12.71	123.08	184.29	4.17	0.36	3.57	51.64	50.79	0.00
SL2E	0.57	0.00	31.43	0.00	0.00	0.07	0.71	1.36	0.00
SL3W	5.64	34.62	66.07	0.00	0.00	0.64	135.36	28.93	0.21
SL3E	0.86	0.00	73.07	1.25	1.00	2.07	1.14	7.07	0.00
SL4W	4.64	0.00	27.86	0.00	2.00	0.00	64.64	35.00	0.07
SL4E	0.57	0.00	4.29	0.00	0.00	0.36	1.21	3.71	0.00
SL5W	2.00	0.00	71.71	0.00	0.57	0.50	5.07	13.79	0.00
SL5E	0.00	0.00	7.86	0.00	0.00	0.00	0.64	3.57	0.00
HA1	0.79	341.54	209.36	28.83	13.71	0.00	32.21	75.64	0.00
HA2	0.93	138.46	132.93	0.17	57.21	0.14	30.50	79.36	0.21
HA3	0.79	0.00	110.07	4.17	75.36	0.00	18.71	64.57	0.00
SN1	0.07	42.31	24.64	0.00	5.14	0.07	1.64	2.93	0.00
SN2	1.86	0.00	116.79	0.00	9.64	0.07	13.79	66.36	0.07
SN3	5.29	0.00	95.50	0.00	38.00	0.00	1.50	38.50	0.00
MA1W	2.14	0.00	12.79	0.00	18.93	0.00	10.36	14.07	0.00
MA1E	0.07	0.00	4.29	0.00	11.07	0.00	0.21	3.14	0.00
LO1W	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.21	1.57
LO1E	0.14	0.00	0.00	0.00	0.00	0.00	0.64	1.21	0.00

Table 4. *Mean density of waterfowl (number per hectare) in each sub-section of the Ythan estuary; September to March 2006/07. The species codes are: MS – Mute Swan; SU – Shelduck; WG – Wigeon; MA – Mallard; RM – Red-breasted Merganser; CA – Cormorant; H. – Heron.*

	Species						
Section	MS	SU	WG	MA	RM	CA	H.
MO1W	0.00	0.00	0.00	0.00	0.02	0.07	0.04
MO1E	0.00	0.00	0.00	0.00	0.04	0.00	0.00
MO2W	0.00	0.00	0.43	0.00	0.08	0.05	0.06
MO2E	0.00	0.10	1.49	0.00	0.35	0.10	0.40
IN1W	0.00	0.18	0.18	0.02	0.05	0.03	0.05
IN1E	0.00	0.03	0.95	0.00	0.19	0.12	0.10
IN2W	0.00	0.20	1.02	0.98	0.06	0.06	0.10
IN2E	0.00	0.11	0.17	0.00	0.11	0.22	0.06
IN3W	0.04	0.05	2.60	0.13	0.17	0.04	0.13
IN3E	0.00	0.06	0.56	0.00	0.11	0.04	0.11
QU1W	0.00	0.00	0.09	0.00	0.04	0.04	0.07
QU1E	0.00	0.05	5.33	0.00	0.08	0.18	0.10
QU2W	0.00	0.04	1.01	0.43	0.25	0.00	0.07
QU2E	0.00	0.07	4.62	0.11	0.15	0.06	0.07
TA1	0.12	0.10	0.00	0.03	0.00	0.00	0.07
SL1W	0.10	0.26	1.25	0.05	0.19	0.13	0.08
SL1E	0.27	0.03	2.87	0.19	0.10	0.12	0.18
SL2W	0.26	0.74	0.76	0.00	0.00	0.16	0.02
SL2E	0.00	0.58	0.00	0.17	0.00	0.00	0.46
SL3W	0.69	0.65	5.44	0.02	0.01	0.13	0.06
SL3E	0.38	1.03	7.67	0.24	0.00	0.00	0.00
SL4W	0.00	0.07	0.28	0.00	0.05	0.04	0.01
SL4E	0.43	0.85	0.40	0.48	0.20	0.04	0.00
SL5W	0.90	0.00	0.38	0.66	0.14	0.07	0.21
SL5E	1.21	0.06	0.00	0.00	0.03	0.03	0.36
HA1	0.17	0.88	0.00	0.52	0.01	0.00	0.02
HA2	0.01	0.06	0.00	0.03	0.00	0.06	0.03
HA3	0.05	0.22	0.00	0.00	0.00	0.18	0.01
SN1	0.04	0.03	0.29	0.13	0.03	0.20	0.08
SN2	0.02	0.80	0.46	0.32	0.02	0.38	0.24
SN3	0.05	0.14	0.79	0.06	0.00	0.05	0.06
MA1W	0.00	0.26	0.00	0.26	0.00	0.07	0.05
MA1E	0.12	0.16	0.00	0.22	0.00	0.08	0.05
LO1W	0.09	0.17	0.00	0.00	0.00	0.00	0.09
LO1E	0.00	0.00	0.00	0.26	0.11	0.16	0.16

Table 5. *The mean density of waders (number per hectare) in each sub-section of the Ythan estuary; September to March 2006/07. The species codes are: OC – Oystercatcher; GP – Golden Plover; L. – Lapwing; KN – Knot; DN – Dunlin; BA – Bar-tailed Godwit; CU – Curlew; RK – Redshank; TT – Turnstone.*

	Species								
Section	OC	GP	L.	KN	DN	BA	CU	RK	TT
MO1W	1.93	0.00	0.00	0.00	0.00	0.02	0.04	0.11	0.07
MO1E	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MO2W	7.61	0.00	0.00	0.00	0.00	0.14	0.24	0.50	0.44
MO2E	23.18	0.00	0.05	0.00	0.00	0.27	2.48	0.62	0.32
IN1W	5.66	0.00	0.03	0.00	0.06	0.42	1.29	1.04	0.42
IN1E	1.92	0.00	0.00	0.00	0.00	0.20	0.27	0.02	0.00
IN2W	3.32	0.25	0.55	0.00	0.00	0.05	2.76	1.03	0.22
IN2E	5.55	0.00	0.00	0.00	0.00	0.11	1.07	1.18	0.00
IN3W	0.87	0.56	13.53	2.51	0.16	0.38	0.62	4.31	0.03
IN3E	4.12	90.90	1.57	0.02	0.00	0.21	1.93	1.05	0.34
QU1W	0.36	0.00	2.05	0.00	0.00	0.77	0.25	0.95	0.14
QU1E	4.96	0.58	6.80	1.36	0.00	0.80	1.09	1.53	0.03
QU2W	0.87	0.00	6.52	0.00	0.00	0.40	0.68	0.58	0.00
QU2E	1.13	2.75	4.78	0.00	0.00	0.21	0.26	0.99	0.01
TA1	0.78	0.00	4.42	0.00	0.00	0.00	2.88	4.69	0.00
SL1W	0.41	0.00	9.04	1.74	0.01	0.04	0.16	1.92	0.02
SL1E	0.58	0.00	38.30	0.00	0.00	0.13	0.27	0.61	0.00
SL2W	0.68	6.61	9.90	0.22	0.02	0.19	2.77	2.73	0.00
SL2E	0.33	0.00	18.33	0.00	0.00	0.04	0.42	0.79	0.00
SL3W	0.50	3.08	5.88	0.00	0.00	0.06	12.04	2.57	0.02
SL3E	0.35	0.00	30.17	0.52	0.41	0.86	0.47	2.92	0.00
SL4W	0.46	0.00	2.77	0.00	0.20	0.00	6.44	3.49	0.01
SL4E	0.32	0.00	2.41	0.00	0.00	0.20	0.68	2.09	0.00
SL5W	0.66	0.00	23.84	0.00	0.19	0.17	1.69	4.58	0.00
SL5E	0.00	0.00	3.34	0.00	0.00	0.00	0.27	1.52	0.00
HA1	0.05	22.62	13.87	1.91	0.91	0.00	2.13	5.01	0.00
HA2	0.08	12.19	11.70	0.01	5.04	0.01	2.69	6.99	0.02
HA3	0.10	0.00	14.35	0.54	9.82	0.00	2.44	8.42	0.00
SN1	0.01	7.84	4.57	0.00	0.95	0.01	0.30	0.54	0.00
SN2	0.29	0.00	18.07	0.00	1.49	0.01	2.13	10.27	0.01
SN3	1.17	0.00	21.06	0.00	8.38	0.00	0.33	8.49	0.00
MA1W	0.71	0.00	4.25	0.00	6.30	0.00	3.45	4.68	0.00
MA1E	0.03	0.00	1.63	0.00	4.22	0.00	0.08	1.20	0.00
LO1W	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.13	0.94
LO1E	0.11	0.00	0.00	0.00	0.00	0.00	0.47	0.90	0.00

APPENDIX 3. Percentage cover and biomass of algae on the Ythan estuary in 2007

Table 1. *Percentage cover of algae in 2007.*

		Date					
	Site	6 July	30 July	13 Aug	22 Aug	4 Sept	20 Sept
1	Mouth	90	20	80	90	70	80
2	Golf Course	80	80	90	90	70	60
3	Foveran Burn	95	90	100	90	90	80
4	South Quay	40	20	80	60	80	60
5	Grassy Car Park	95	95	100	90	70	50
6	Tarty	60	55	90	60	60	70
7	South Sleek	70	30	70	60	20	0
8	North Sleek	100	90	80	80	30	5
9	East Haddo	40	40	70	70	5	0
10	West Haddo	5	40	70	60	80	0
	Mean	67.5	56.0	83.0	75.0	57.5	40.5
	Median	75.0	47.5	80.0	75.0	70.0	55.0
	Maximum	100	95	100	90	90	80
	Minimum	5	20	70	60	5	0
	Upstream median	60.0	40.0	70.0	60.0	30.0	0.0
	Downstream median	90.0	80.0	90.0	90.0	70.0	60.0
	Upstream mean	55.0	51.0	76.0	66.0	39.0	15.0
	Downstream mean	80.0	61.0	90.0	84.0	76.0	66.0

Table 2. *Biomass of algae (wet weight (kg) per square metre) in 2007.*

	Site	Date 6 July	30 July	13 Aug	22 Aug	4 Sept	20 Sept
1	Mouth	0.53	0.38	3.12	2.00	1.04	1.12
2	Golf Course	1.04	1.62	2.00	1.28	0.88	0.96
3	Foveran Burn	2.32	0.80	1.44	1.20	1.36	1.04
4	South Quay	0.80	0.29	2.72	1.52	2.88	1.76
5	Grassy Car Park	0.85	1.02	1.28	0.80	0.96	0.48
6	Tarty	0.98	0.90	2.00	2.08	0.96	0.64
7	South Sleek	1.01	0.53	2.16	1.60	0.80	0.00
8	North Sleek	2.02	1.70	2.64	1.68	0.64	0.00
9	East Haddo	0.35	0.61	1.20	1.36	0.00	0.00
10	West Haddo	0.59	0.40	1.20	1.20	0.72	0.00
	Mean	1.05	0.82	1.98	1.47	1.02	0.60
	Median	0.91	0.70	2.00	1.44	0.92	0.56
	Maximum	2.32	1.70	3.12	2.08	2.88	1.76
	Minimum	0.35	0.29	1.20	0.80	0.00	0.00
	Upstream median	0.98	0.61	2.00	1.60	0.72	0.00
	Downstream median	0.85	0.80	2.00	1.28	1.04	1.04
	Upstream mean	0.99	0.83	1.84	1.58	0.62	0.13
	Downstream mean	1.11	0.82	2.11	1.36	1.42	1.07

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ISBN: 978-1-78391-267-4

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