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Humber Estuary Bird Decline Investigation 2014

Authors

Ian D. Woodward, Neil A. Calbrade and Chas A. Holt

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The British Trust for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU
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EXECUTIVE SUMMARY

- Several studies have documented population declines in species of waterbird that winter on Humber Estuary SPA and are protected as non-breeding features. With a few exceptions, the reasons for these declines are not clear cut.

- This project brought together findings from a wide range of studies to the identify drivers of population change on the Humber Estuary, where possible, for 23 species, and to make recommendations about measures that could be taken to halt or reverse these trends.

- The basis for this report was the collation of an extensive review of the literature relating to food resources, habitats, and anthropomorphic pressures that may influence waterbird distribution on the Humber Estuary. We combined the above information with an extensive consultation of the Humber Estuary SPA stakeholder community.

- For each waterbird species we have collated information on population trends, general and local ecology (diet, habitat preferences, behaviour and sensitivity to disturbance), known reasons for both general and local declines, potential threats and detail of species distribution within the Humber Estuary.

- There is considerable information relating to the Humber Estuary complex, however there remains a need for more information reported in a systematic manner that would allow trends in different parts of the site to be correlated with environmental variables.

- With the aim of highlighting potential drivers of change at the level at which waterbird numbers are routinely recorded, waterbird trends at the WeBS sector level were cross-tabulated against the information on potential drivers of change. As expected given the previous statement, the resulting cross-tabulation table contains many empty cells, not because the potential driver is not operating on that particular sector but because there is no direct evidence either way.

- There are clearly many anthropomorphic activities that have a long history on the Humber. These are likely to be responsible, at least in part, for present day number and distribution of waterbirds. However, on-going changes in flyway scale distribution are likely to be responsible for differing background population trajectories between species.

- Food availability clearly affects the abundance and trends in waterbirds, but there is little direct evidence linking changes on food availability to waterbird abundance.

- There is a need for better understanding of precisely how non-breeding waterbirds use the estuary. This could be potentially achieved through a combination of detailed radio telemetry studies of focus species, and the establishment of a coordinated programme of colour ringing to investigate patterns of 'turnover'.

- This study has highlighted several site-based pressures that are likely to be accentuating effects of wider environmental change (i.e. principally avian responses to climate). A range of possible management measures could be considered. In specific parts of the Humber, we suggest the most pertinent of these relate to habitat change and possible disturbance (inner Humber), mitigating impacts of development (mid Humber) and limiting disturbance from recreational activities (outer Humber). Pertinently, effects of disturbance from wildfowling in some parts of the estuary need further investigation.

1 INTRODUCTION

1.1 Background and aims

The Humber Estuary, located on the east coast of England, is one of the largest estuarine systems in the UK. It is fed by the river Humber and as such, drains much of Midlands and northern England. The estuary comprises very extensive saltmarshes, major intertidal banks of sand and mud, shallow waters and deep channels. The eastern end of the site includes the narrow headland ending at Spurn Point.

The Humber Estuary is a large macro-tidal coastal plain estuary with high suspended sediment loads, which feed a dynamic and rapidly changing system of accreting and eroding intertidal and subtidal mudflats, sandflats, saltmarsh and reedbeds. The estuary supports a full range of saline conditions from the open coast to the limit of saline intrusion on the tidal rivers of the Ouse and Trent. The range of salinity, substrate and exposure to wave action influences the estuarine habitats and the range of species that utilise them. These include a breeding bird assemblage, winter and passage waterfowl, river and sea lamprey, grey seals, vascular plants and invertebrates. The intertidal flats have a particularly rich invertebrate fauna which are important food sources for the large numbers of waterbirds dependent on this site.

The Humber Estuary is one of the largest protected sites in the country and has exceptional wildlife importance. It is one of the primary estuaries for wintering waterbirds in the UK, supporting a minimum estimate of approximately 131,300 individuals annually (excluding introduced species) during the years of 2008/09 to 2012/13 (Austin *et al.* 2014), including internationally important numbers of 22 species (Stroud *et al.* 2001). This importance is recognised and protected through its designation as a Special Protection Area (SPA), Ramsar Site, National Nature Reserve (NNR) and Site of Special Scientific Interest (SSSI). The Humber Estuary SPA extends to over 37,630 ha (Figure 1).

As part of its programme of monitoring the condition of designated sites, Natural England is required to assess the size of bird populations on those sites where they are a feature of interest, compare current numbers with the population at the time of designation in order to identify changes, and put in place measures to address any decline that is considered to make the site's condition unfavourable.

The monitoring and condition assessments of non-breeding waterbird features on SSSIs and SPAs are generally based upon data from the Wetland Bird Survey (WeBS). WeBS is a long-running survey that monitors waterbird numbers on sites throughout the UK via monthly site visits, when numbers of all waterbird species are recorded (Austin *et al.* 2014). On large sites, such as the Humber Estuary, where it is not feasible, or indeed desirable, to make a single count for the entire site, synchronous counts of smaller count areas, known as "WeBS sectors" are undertaken (Figure 1), the results of which are then summed to give the overall site total. Large WeBS sectors are further subdivided into smaller ones (Figure 2).

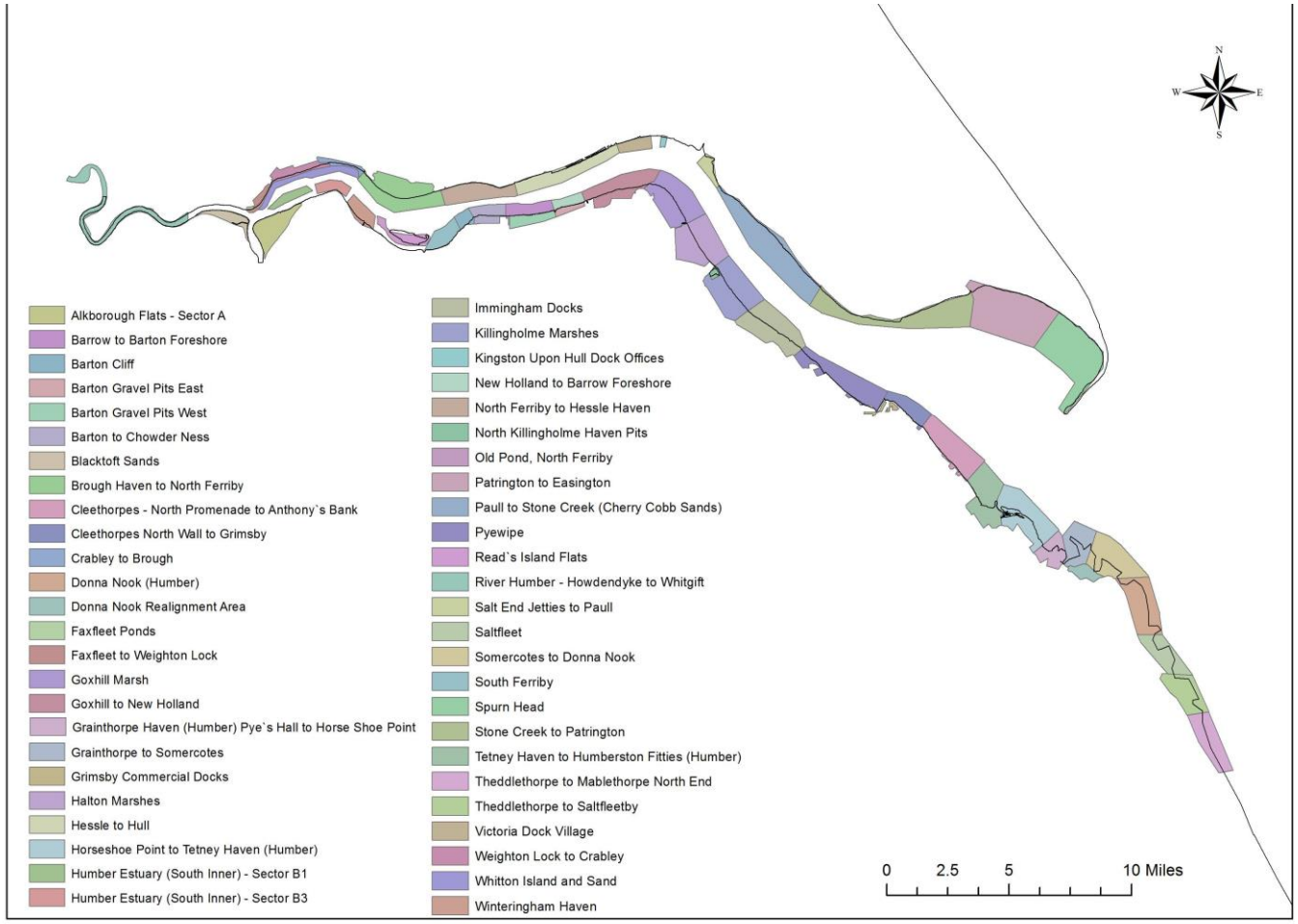
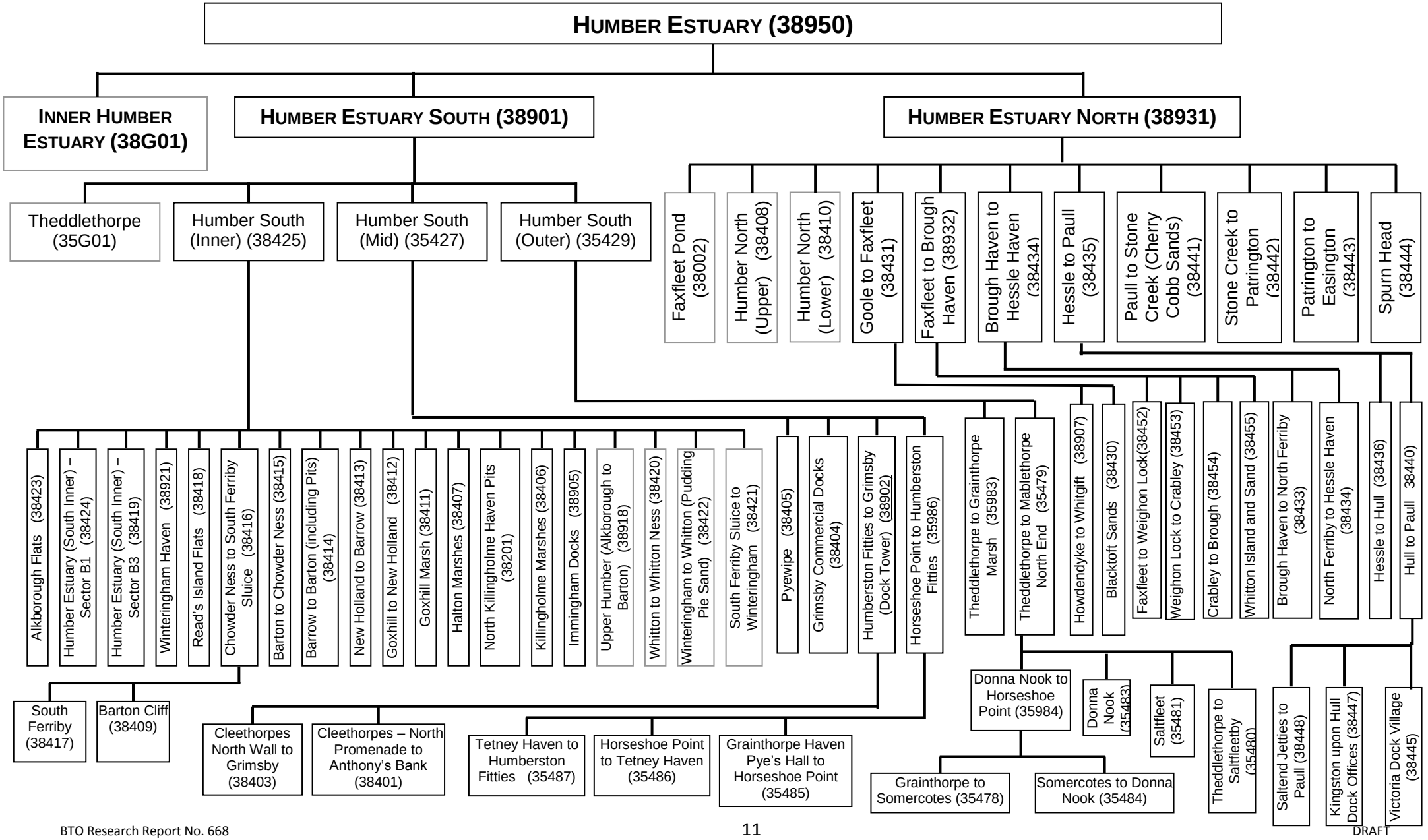


Figure 1. Map of the Humber Estuary, showing visual impression of layout of WeBS sectors and the extent of protected areas. Site names relate to WeBS count areas referred to in this report.

Figure 2. Structural hierarchy of WeBS count sectors on Humber Estuary SPA.



The condition assessment of the non-breeding waterbird features carried out in 2010 for the Humber Estuary using the Wetland Bird Survey (WeBS) data by the British Trust for Ornithology (BTO) indicated that there were several bird species of concern whose populations appeared to be in decline. For some of these species, the decline within the estuary was either greater than regional or national trends or contrary to those wider trends (*i.e.* a decline in the Humber while the wider population was increasing). Subsequent analysis of the more recent WeBS data has suggested a similar picture.

The overall aim of the proposed project is to capture information sources and try to use them to answer the questions associated with changing bird populations on the Humber. The specific objectives of the project are to, where possible:

- Identify the principal factors limiting resource availability and influencing the observed declines of each of the waterbird species of concern in Humber Estuary through a systematic review of existing evidence, ecological literature and expert knowledge.

- Identify any gaps in existing knowledge which are a barrier to understanding why the declines are taking place.

- Recommend conservation measures and actions that could ameliorate the declining population.

Two main sources of information are used to inform the reasons behind the changing populations of these species on the Humber Estuary:

- Empirical scientific evidence including various data sets, surveys, studies, and ecological literature.

- The expertise, knowledge and experience of a number of key professionals working on Humber bird conservation.

1.2 Species of concern

This report is restricted to dealing with species for which there is evidence of decline either across the Humber Estuary as a whole or on WeBS count sectors important to a given species. Two principal sources of information have been used to derive this list; the WeBS Alerts Report (Cook *et al.* 2013) and the WeBS sector-level analysis of Ross-Smith *et al.* (2013) (Table 1).

The 23 species of waterbird relevant to the Humber Estuary SPA designation: Pink-footed Goose, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Mallard, Pochard, Scaup, Goldeneye, Oystercatcher, Ringed Plover, Golden Plover, Lapwing, Knot, Sanderling, Dunlin, Ruff, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Greenshank and Turnstone.

Table 1 Humber Estuary SPA species considered in this review. Species that have triggered a WeBS Alert are automatically included, with other species considered for the reasons stated. The reference year for the WeBS Alerts is 2009/10 (Cook *et al.* 2013). Red = high alert (decline of >50% over period stated), Orange = medium alert (decline of 25-50% over period stated). n/a = not available (species not included in WeBS Alerts)

Species	Short-term trend (5 years)	Medium-term trend (10 years)	Long-term trend (up to 25 years)	Other
Pink-footed Goose *Anser brachyrhynchus*	n/a	n/a	n/a	Potential conflicts with agriculture within hinterland
Dark-bellied Brent Goose *Branta bernicla bernicla*	17	15	18	Some evidence of redistribution (Ross-Smith *et al.* 2013).
Shelduck *Tadorna tadorna*	-2	3	-33	
Wigeon *Anas penelope*	-38	-22	-40	
Teal *Anas crecca*	12	53	25	
Mallard *Anas platyrhynchos*	-17	-19	-70	
Pochard *Aythya ferina*	-41	-12	10	
Scaup *Aythya marila*	n/a	n/a	n/a	Declines in population noted (per local observers)
Goldeneye *Bucephala clangula*	-28	-32	261	
Oystercatcher *Haematopus ostralegus*	4	-21	-6	Some evidence of redistribution (Ross-Smith *et al.* 2013).
Ringed Plover *Charadrius hiaticula*	-53	-69	-64	
Golden Plover *Pluvialis apricaria*	-45	-13	342	
Lapwing *Vanellus vanellus*	-49	-42	108	
Knot *Calidris canutus*	-8	15	18	Some evidence of redistribution (Ross-Smith *et al.* 2013).
Sanderling *Calidris alba*	11	-24	-20	
Dunlin *Calidris alpina*	-17	-28	-34	
Ruff *Philomachus pugnax*	n/a	n/a	n/a	Limited information available

Species	Short-term trend (5 years)	Medium-term trend (10 years)	Long-term trend (up to 25 years)	Other
Black-tailed Godwit *Limosa limosa*	-28	-2	827	
Bar-tailed Godwit *Limosa lapponica*	-7	-2	70	Some evidence of redistribution (Ross-Smith *et al.* 2013).
Curlew *Numenius arquata*	3	1	83	
Greenshank *Tringa nebularia*	n/a	n/a	n/a	Limited information available
Redshank *Tringa totanus*	-31	-42	3	
Turnstone *Arenaria interpres*	n/a	n/a	n/a	Limited information available

2 METHODS

2.1 Literature search

2.1.1 Waterbird accounts

The status of each species at site, regional and national level are reviewed and presented in a series of species accounts. A thorough literature search was undertaken to enable inclusion within these reviews of summaries of the ecology of each species, including diet and behaviour, and how these variables may be linked to potential environmental factors affecting each species on the SPA.

2.1.2 Review of background information relating to environmental factors on the Humber

A thorough literature search was carried out to inform potential drivers affecting populations of the species concerned on Humber Estuary SPA. This considered empirical scientific evidence, including various datasets, surveys, studies, and ecological literature. We present these in a series of sections.

2.2 Stakeholder consultation

2.2.1 Summary of Natural England workshops

Natural England organised two workshops to initiate discussion about population changes in non-breeding waterbirds on the Humber Estuary. These took place on 15 July 2013 and 24 March 2014. This report uses outputs from these workshops to inform the design of the stakeholder interviews and matrices that were used to collect quantitative information (see 2.3.2 and 2.3.3 below).

2.2.2 Quantified evaluation of pressures

We devised a scoring system which the consulted experts used to rate the importance of particular threats on the bird species of concern. We asked all the experts to score a list of threats (identified in the above workshops) on a species by species basis. Scores were allocated from 0 to 5, inclusive, depending on the perceived severity of a negative pressure on a particular species. This exercise was undertaken at different spatial scales – four large areas (Inner Humber, Mid Humber, Outer Humber North, Outer Humber South) to a finer scale provided by individual WeBS Count sectors (Figs. 1, 2).

2.2.3 Interviews with local experts and stakeholder group representatives

Expert opinion was sought to supplement the information gleaned from the literature review, and particularly to inform detail concerning potential pressures on the Humber where published information was lacking. In order to ensure more anecdotal information and evidence was harnessed from local knowledge we undertook telephone interviews with local stakeholders. A series of fixed questions were asked, and issues raised by the matrices were also discussed.

2.3 Identification of relationships between species trends and factors

Having reanalysed the sector level trends for the species of interest in this study, we tabulated species' trends against identified pressures. This information is presented in an extensive table that provides a visual image of the status and pressures faced by species on the SPA. It also enables pertinent issues for individual species to be identified and draws attention to commonalities.

3 RESULTS

3.1 Literature Review: waterbird accounts

Using information collated during the literature review, the bird species accounts which follow are presented in tabular form organised into the following topic areas:

- ***Population estimates***: the number of individuals at the time of designation, and the use of asterisks to denote where the most recent five-year mean for Humber Estuary (as counted for WeBS) (Austin *et al.* 2014) surpasses national (*) and international (**) thresholds.

- ***Trends***: the percentage change in numbers since classification and the WeBS short, medium- and long-term trends (5, 10 & 25 years) for the Humber Estuary as a whole, sourced from the WeBS Alerts Report (Cook *et al.* 2013); trends within the Humber Estuary individual count sections, typically those identified by Ross-Smith *et al.* (2013), and how trends on the Humber Estuary compare with those in the broader context of the East of England and Great Britain (from Cook *et al.* 2013). For the purposes of Humber Estuary versus region comparisons in WeBS Alerts, the East of England is defined as Northumberland to Essex.

  WeBS Alert trends may appear to contradict the most recent population estimates due to the most recent WeBS Alert data relating to Humber Estuary SPA and using 2009/10 as the reference year, whereas the most recent population estimate uses the five-year mean peak for the Humber Estuary count area (as used by WeBS) up to 2012/13.

- ***Links:*** useful web links to a broad range of information on species ecology including information beyond that of immediate concern within this report.

- ***General Ecology***: general information on diet, habitat, behaviour and sensitivity to disturbance. This can be considered typical for the species and can be used to infer information regarding birds on The Humber in the absence of site-specific information.

- ***Local Ecology***: information on species ecology with specific reference to the Humber Estuary or at least relatively local to the Humber Estuary.

- ***Origin***: information regarding the breeding origins of birds frequenting the Humber Estuary during the non-breeding season.

- ***Reasons for decline***: known reasons for decline on the Humber Estuary. Additionally we list factors that are known to affect numbers more widely.

- ***Potential threats***: generic threats that have been shown to affect the species elsewhere and hence have the potential to impact numbers on the Humber Estuary.

Distribution: Here we deal with distribution of the species within the Humber Estuary. Sector-level distribution maps from Ross-Smith *et al.* (2013) are shown. We first present distributions from data collected as part of the WeBS Low Tide Count Scheme (from Calbrade 2013) to indicate how birds use the site. This is accompanied by depictions of the WeBS sector counts for each of the five-winter periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11. Maps are not included for diving wildfowl as these were not included in Ross-Smith *et al.* (2013) or by WeBS Low Tide Counts.

Table 2. PINK-FOOTED GOOSE (*Anser brachyrhynchus*)

POPULATION ESTIMATES	AT CLASSIFICATION: Not listed on Natura 2000 designation form (JNCC 2014). WeBS 5-year peak mean as of winter 2012/13: **4,581**** (Austin *et al.* 2014)
TRENDS	Site trends not available. This species is not included in WeBS Alerts (as monitored by alternative scheme; WWT/JNCC/SOC Goose & Swan Monitoring Programme). Sector trends: Despite possible caveats associated with WeBS data for this species, it was included by Ross-Smith *et al.* (2013). In the Inner Humber, there is evidence of medium and long term increases at the most important site (Read's Island Flats), but declines have occurred over all three timescales at Blacktoft Sands, Faxfleet to Brough Haven and Barton Cliffs. Increases have occurred at Cherry Cobb Sands (middle Humber), and a strong decrease at Theddlethorpe to Mablethorpe North End (Outer South) (Ross-Smith *et al.* 2013). Regional trend comparison: not considered for WeBS Alerts
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=374** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob1580.htm**
GENERAL ECOLOGY	DIET: Herbivorous. Outside the breeding season feeds on improved grasslands, cereal stubbles and vegetables (e.g. potatoes, sugar beet, carrots) (Kear 2005a). HABITAT: Feeds on farmland, and usually roosts on estuaries (Kear 2005a). Foraging areas normally less than 10km away from roost sites with an optimum distance of 2-5km (Vickery and Gill 1999 in Birdlife 2014) BEHAVIOUR: Highly gregarious, roosting and feeding in large flocks numbering in the thousands. Persistent use of favoured feeding sites within the same winter and during subsequent winters, especially when little disturbed (Kear 2005a). SENSITIVITY TO DISTURBANCE: Unknown
LOCAL ECOLOGY	In the Humber SPA, almost exclusively found on Read's Island, which it uses a roosting site, flying inland during the day to feed in fields (Calbrade 2013). Pink-footed Geese move up to 20kms and possibly 30kms from the Humber roosts at the moment into West Yorkshire, North Yorkshire and Lincolnshire down the Wolds and out to the coast but mostly concentrated within 10kms of the Read's Island roost (G. Catley, pers. comm.).
ORIGIN	The Pink-footed Geese wintering in the UK are from the population breeding in Iceland and Greenland (Wernham *et al.* 2002; Kear 2005a). Many birds stage in Scotland in the autumn before moving further south in late autumn and early winter (Wernham *et al.* 2002)
REASONS FOR DECLINE	There is no evidence of a decline in total numbers of this species at the site, but evidence of possible redistribution within the site. Disturbance may potentially be having an effect in some sectors. There has been a marked decline in the amount of sugar beet being grown in recent years, especially in North Lincolnshire which may force birds to move further afield in search of food.

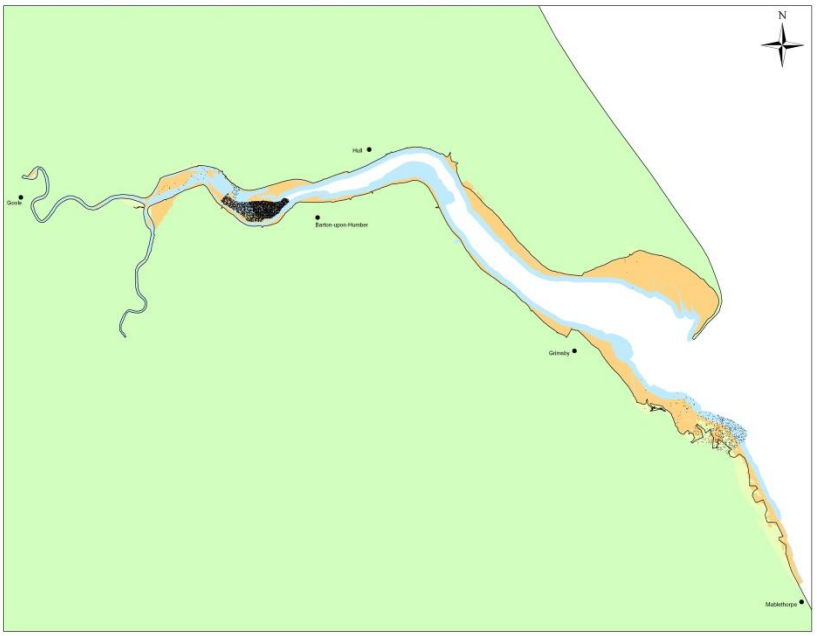
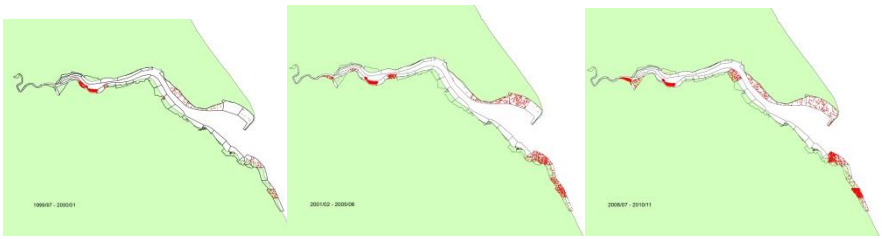
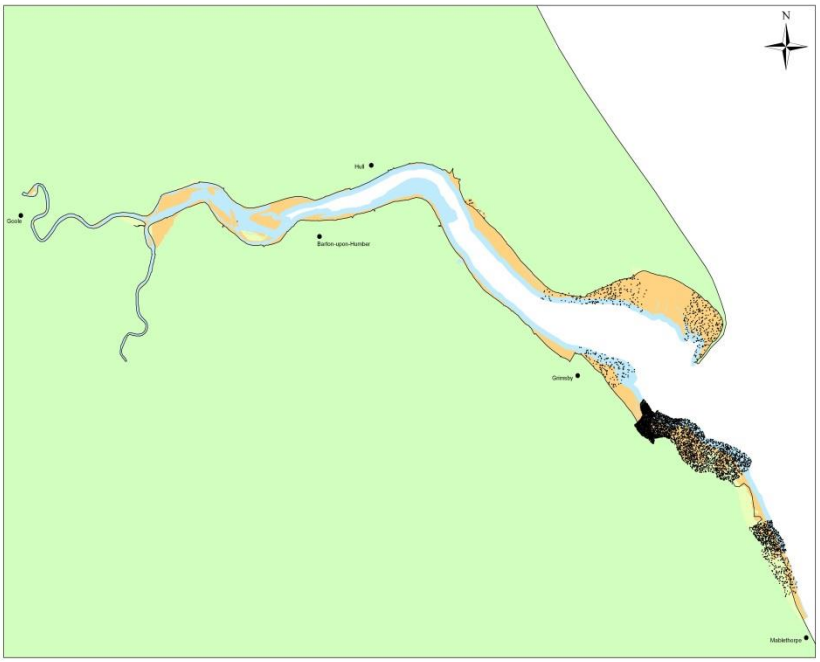
POTENTIAL THREATS	Hunting may be a threat as the species is a quarry species in all countries where it occurs, though many roost sites are in protected areas. Damage to crops, especially to improved grass in the spring, may create conflict with farmers, especially if numbers continue to increase (Kear 2005a). As a result, there has been an increase in shooting of birds on feeding areas away from the estuary itself (G. Catley, pers. comm.).
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.   Relative distribution within The Humber has increased over the three periods.

Table 3. DARK-BELLIED BRENT GOOSE (*Branta bernicla bernicla*)

POPULATION ESTIMATES (HUMBER)	AT CLASSIFICATION: **2,098** in winter (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **2,934**** (Austin *et al.* 2014)
TRENDS (HUMBER)	Short-term trend: +17% Medium-term trend: +15% Long-term trend: +18% Sector trends: Present on middle and outer Humber only. High alert in the medium and long-terms at Cherry Cobb Sands (Middle Humber). In the Outer South a redistribution of Brent Geese flocks has occurred, with high alerts at Donna Nook and Theddlethorpe to Saltfleetby being offset by high increases at Somercoates to Donna Nook, now the most important sector in the Outer South. In the Outer North, numbers have remained relatively stable with short to medium term increases and Spurn Head is the most important sector (Ross-Smith *et al.* 2013). UK/Region trends: No alerts have been triggered for Brent Geese on the Humber Estuary SPA, with trends being stable in the medium trend having previously increased. The proportion of regional numbers using the SPA has remained stable (Cook *et al.* 2013).
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=386** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob1680.htm**
GENERAL ECOLOGY	DIET: Plants. Preferred food eelgrass *Zostera spp*., *Ulva lactuca* also important, but many other estuarine plants are listed as food sources (Kear 2005a). Also inland near coast esp. on *Lolium perenne* (Vickery & Gill 1999 in Birdlife 2014) HABITAT: Usually roosts on estuaries and feeds on plants below the high water mark (Kear 2005a). Over last 20 years, increasing use of coastal grassland and winter cereal crops as feeding habitat (Kear 2005a). BEHAVIOUR: Gregarious, occurring in small to large flocks during winter, grazing on plants (Kear 2005a). A sequential pattern of habitat use may occur as birds deplete preferred saltmarsh species in turn before switching to inland food sources (Ward 2004 in WWT 2014a) SENSITIVITY TO DISTURBANCE: This species is disturbed by vehicle movement in the UK, but in some situations can be relatively tolerant of human disturbances such as walkers nearby (Burton *et al.* 2002a). Displacement from preferred feeding habitats is therefore a possible impact for birds that use the estuary throughout the winter. On the Wadden Sea, pressure of recreational activity was found to limit numbers of Brent Geese using an area (Stock 1993). Tourists were the most frequent disturbing factor whilst the geese were found to be particularly sensitive to planes and helicopter activity. When disturbance was high, birds took refuge in undisturbed areas of saltmarsh. Another study on the North Norfolk Coast showed walkers to be the most frequent disturbance factor but that 'mechanised' activities (e.g. gunshots and aircraft) cause greatest energy expenditure (Riddington *et al.* 1996).

ECOLOGY (HUMBER)	The most important area in the Humber SPA for wintering Brent Geese is the North Lincolnshire coast between Tetney and Donna Nook (Outer South area) (Calbrade 2013; Ross-Smith *et al.* 2013). Spurn is also important during spring passage (Calbrade 2013). A distribution model for Brent Goose on the Humber included six environmental variables as predictors of distribution in estuarine areas, explaining 79% of density data variability. The intertidal area was the most important predictor of the occurrence of this species, but the combination of intertidal area with other habitats was also important (Franco *et al.* 2013). A lack of suitable hinterland for feeding restricts available feeding sites away from the estuary though the Long Bank area of Spurn is frequently used by feeding birds.
ORIGIN	Breeds Arctic coast of Russia (Birdlife 2014).
REASONS FOR DECLINE	There is no evidence of a decline for this species. SITE SPECIFIC (HUMBER): The site trend mirrors regional and national trends suggesting that conditions on site remain relatively favourable for this species (Cook *et al.* 2013). Disturbance may be having an effect in some sectors. Fearnley *et al.* (2012) highlighted Donna Nook and Saltfleet as two areas where visitor activity occurred in close proximity to areas used by Brent Geese. WeBS alerts have been raised in both these sectors and in the adjacent Theddlethorpe to Saltfleetby sector, with a strong increase in counts occurring in the Somercoates to Donna Nook sector to the north. However, the study did not measure actual disturbance, and alerts have not been triggered in another area highlighted by Fearnley *et al.* (Horseshoe Point/The Fitties/Northcoates Point).
POTENTIAL THREATS	The return of a disease affecting its preferred food eelgrass may threaten this species in the future (Scott & Rose 1996, in Birdlife 2014). This disease is thought to have been responsible for reductions in Brent Goose numbers in the 1930s (Kear 2005a).
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.



Relative distribution within The Humber has not changed over the three periods

Table 4. SHELDUCK (*Tadorna tadorna*)

POPULATION ESTIMATES (HUMBER)	AT CLASSIFICATION: **4,464** wintering (1.5% of the north-western European population, 1996/7 to 2000/1) (JNCC 2014). WeBS 5-year peak mean as of winter 2012/13: **4,351**** (Austin *et al.* 2014)
TRENDS (HUMBER)	Short-term trend: -2% Medium-term trend: +3% Long-term trend: -33% (decline in late 80s and early 90s) Sector trends: Very variable at sector level. In Inner Humber, high alerts for the northern sectors and mixed for the southern sectors, but with high increases at the most important sector (Read's Island Flats). In Outer South, high alerts were triggered at Donna Nook and Theddlethorpe to Saltfleetby, offset by high increases at Somercoates to Donna Nook (Ross-Smith *et al.* 2013) UK/Region trends: Numbers of Shelducks overwintering in the region and in Great Britain have been decreasing in the long-term and in the medium term respectively. The Humber SPA is becoming more important for Shelduck, as the proportion of birds wintering in the region using the site has increased (Cook *et al.* 2013).
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=402** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob1730.htm**
GENERAL ECOLOGY	DIET: Various tiny invertebrates, with small molluscs predominant in north and west Europe, especially *Hydrobia spp.* (Kear 2005a). HABITAT: Prefers saline habitats including muddy and sandy estuaries (Birdlife 2014). BEHAVIOUR: Feeds by digging, scything and dabbling in intertidal area, feeding during both day and night according to the tide times (Kear 2005a). SENSITIVITY TO DISTURBANCE: Burton *et al.* (2002a) found that counts were significantly lower at estuarine count sectors that were closer to footpaths.
LOCAL ECOLOGY	Shelduck are found throughout the estuary but the highest densities during WeBS low tide counts were at Read's Island and Alkborough Flats (Inner Humber) and at Pyewipe, Salt End, Cherry Cobb Sands and Paull Holme Sands (Middle Humber) (Calbrade 2013). Some sectors within the Outer North and Outer South areas are also important as they have high peak counts during WeBS core counts (Ross-Smith *et al.* 2013). A distribution model for Shelduck on the Humber produced six environmental variables as predictors of distribution in estuarine areas, explaining 83% of density data variability. The best fit variables were subtidal and intertidal area. In intertidal area, density increases where littoral mud substratum dominates (Franco *et al.* 2013). Found to be susceptible to disturbance at Saltend, usually needing 200-300m space though some birds did come closer at high tide (Cutts & Allen 1999).

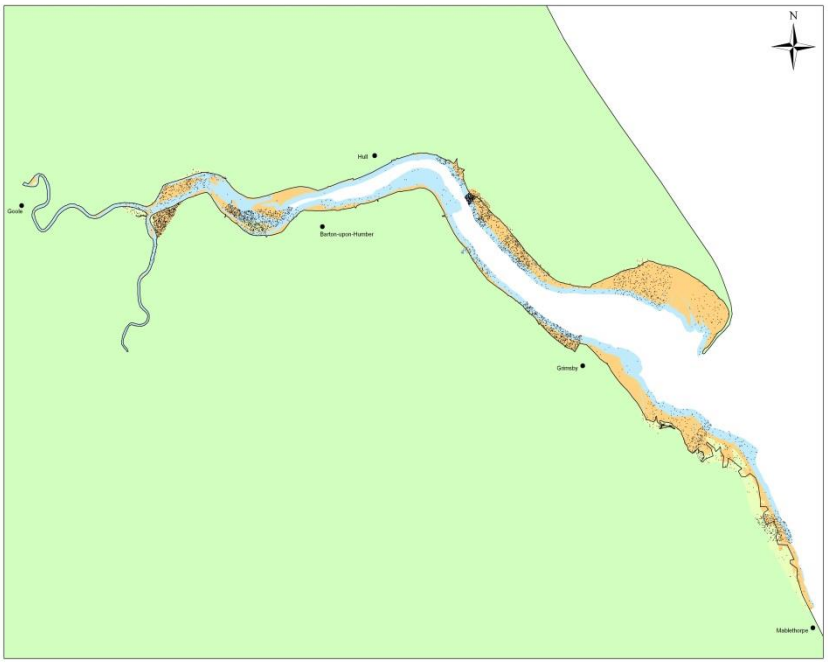
ORIGIN	European breeding populations are largely sedentary, though they undertake short migrations to moulting sites in late summer (Birdlife 2014) when most of the population leaves the UK.
REASONS FOR DECLINE	The trend on site is tracking that of the British trend but in the last twenty years has performed relatively well in comparison to the regional trend. In supporting an increasing proportion of regional numbers, the site is becoming increasingly important for this species (Cook *et al.* 2013).
POTENTIAL THREATS	Habitat loss as a result of tidal barrage schemes in Europe (Kear 2005a). Although Cutts *et al.* (2009) suggest the species can become habituated to human activity, disturbance from favoured areas represents a threat.
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.   Relative distribution within The Humber relatively stable over the three periods

Table 5. WIGEON (*Anas penelope*)

POPULATION ESTIMATES	AT CLASSIFICATION: **5,044** wintering (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **2,676** (Austin *et al.* 2014)
TRENDS	Short-term trend: -38% Medium-term trend: -22% Long-term trend: -40% Sector trends: Alerts have been triggered across all sectors where trends were available along the north of the estuary, and all sectors in the Outer South apart from Saltfleet and Theddlethorpe to Mablethorpe North End where increases have occurred. There were also increases at Donna Nook (Outer South) in the short and medium term despite a high alert for the long term 15 year trend. In contrast, high increases have occurred for all reported sectors on the southern shore between Winteringham Haven (Inner Humber) and Goxhill Marsh (Middle Humber) (Ross-Smith *et al.* 2013). UK/Region trends: In contrast to the long term declines on the Humber SPA, numbers of Wigeon in the region have decreased in the short term after peaking in the mid-2000s and the British trend has been stable in the medium term (Cook *et al.* 2013).
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=429** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob1790.htm**
GENERAL ECOLOGY	DIET: Plants (leaves, stems, stolons, bulbils and rhizomes) (Kear 2005b). HABITAT: Coastal salt-marshes, lagoons, estuaries, intertidal mudflats and sheltered marine habitats (Birdlife 2014). BEHAVIOUR: Gregarious, forming large flocks, often feeding by grazing on land (Birdlife 2014). Can feed at night especially in marine habitats where affected by disturbance and tides (Kear 2005b). Often returns to the same wintering site each winter, but use of wintering sites may change in response to external factors (Wernham *et al.* 2002). SENSITIVITY TO DISTURBANCE: Susceptible to disturbance from increased recreational activity at freshwater sites (Kear 2005b).
ECOLOGY (HUMBER)	The Inner Estuary around the Humber Wildfowl refuge is important for Wigeon, especially Alkborough Flats and Read's Island (Calbrade 2013). Faxfleet to Brough Haven (also Inner Humber) was also highlighted as an important site during WeBS Core Counts (Ross-Smith *et al.* 2013).
ORIGIN	UK birds breed mainly in northern Russia (Wernham *et al.* 2002).
REASONS FOR DECLINE	The site trend does not mirror regional or national trends and suggests that the Alerts are due to site-specific pressures (Cook *et al.* 2013). Disturbance may potentially be having an effect in some sectors. The increase in the population of naturalised Barnacle Geese is thought to have had a detrimental effect on the Wigeon "lawn" between Faxfleet and Brough (N. Cutts, pers comm).

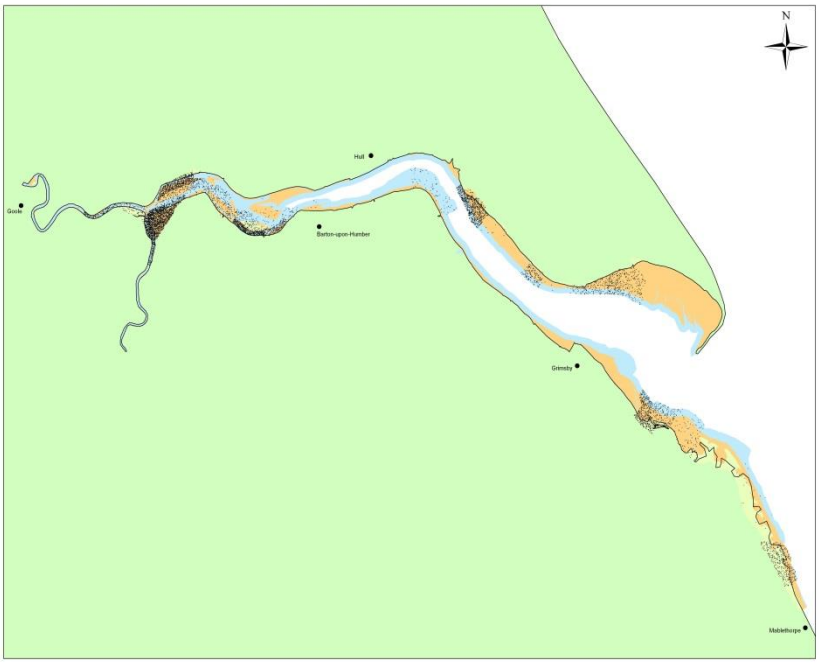
POTENTIAL THREATS	In addition to disturbance from recreation, the species may also be affected by pollution and wetland drainage (Kear 2005b).
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.   Relative distribution within The Humber relatively stable over the three periods.

Table 6. TEAL (*Anas crecca*)

POPULATION ESTIMATES	AT CLASSIFICATION: **2,322** wintering (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **3,546*** (Austin *et al.* 2014)
TRENDS	Short-term trend: +12% Medium-term trend: +53% Long-term trend: +25% Sector trends: Sectors trends were positive in many sectors, especially in the Inner Humber and the Outer South. However, high alerts were raised in six sectors for at least one timescale, including three sectors on the southern shore of the Middle Humber (Goxhill to New Holland; Goxhill Marsh and Killingholme Marshes) (Ross-Smith *et al.* 2013) UK/Region trends: The regional trend for Teal is similar to the trend on the Humber SPA (long-term increases). The British trend is similar with the trend being stable in the medium term following previous increases (Cook *et al.* 2013)
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=31027** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob1840.htm**
GENERAL ECOLOGY	DIET: Wide variety, usually small size sieved from substrate. In winter, seeds often predominate (Kear 2005b). HABITAT: Usually shallow water in freshwater, brackish and intertidal wetlands (Kear 2005b). During winter also occurs along the coast, although shows a preference for marshes with mudflats for feeding over more saline or open water habitats (Johnsgard 1978 in Birdlife 2014). BEHAVIOUR: Will forage at night (Kear 2005b). Usually remains in the same area during winter, unless forced to move due to cold weather (Wernham *et al.* 2002). SENSITIVITY TO DISTURBANCE: Disturbance from recreational activities may pose a threat to this species (Pease *et al.* 2005).
LOCAL ECOLOGY	The Inner Estuary around the Humber Wildfowl refuge is important for Teal, especially Alkborough Flats and Read's Island (Calbrade 2013). Blacktoft Sands was also highlighted as an important site by WeBS core counts (Ross-Smith *et al.* 2013).
ORIGIN	Teal wintering in the UK come from Iceland, northern Europe, the Baltic and a large area of Russia. It is believed that the majority of the Icelandic population winters within Britain and Ireland (Wernham *et al.* 2002)
REASONS FOR DECLINE	The proportion of regional numbers supported by the site remains stable (Cook *et al.* 2013).
POTENTIAL THREATS	Generic threats include habitat loss and degradation, hunting and disturbance (Birdlife 2014).

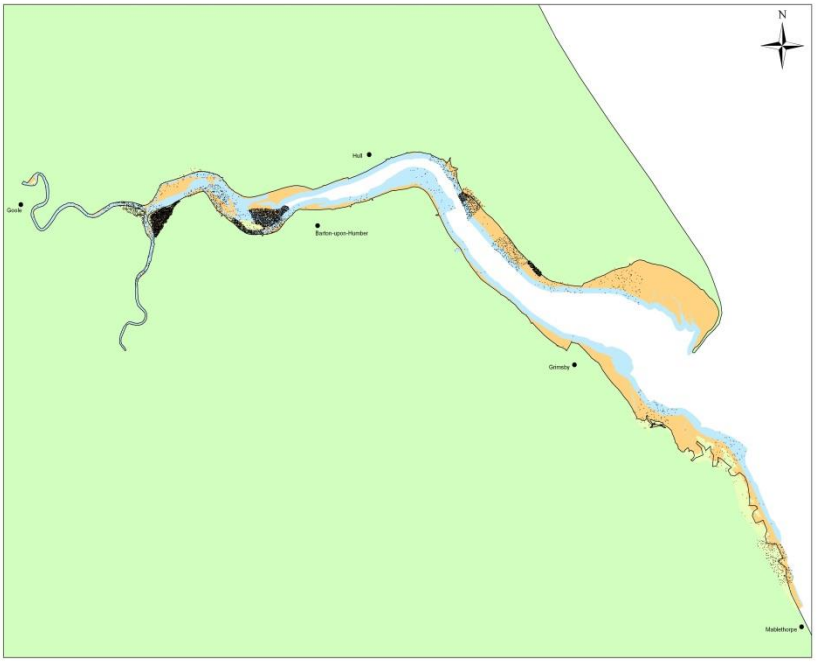
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.   Relative distribution within The Humber relatively stable over the three periods.

Table 7. MALLARD (*Anas platyrhynchos*)

POPULATION ESTIMATES	AT CLASSIFICATION: **2,456** wintering (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **1,617** (Austin *et al.* 2014)
TRENDS	Short-term trend: -17% Medium-term trend: -19% Long-term trend: -70% Sector trends: Trends have been variable across the estuary, with decreases in many areas, including the most important sector (Cherry Cobb Sands, Middle Humber) but some increases possibly reflecting some redistribution of Mallard within the estuary. These included increases between 1994/5 and 2009/10 in all sectors between Barton Pits and Killingholme Marshes on the southern shore of the middle Humber, though there were subsequent decreases during 2004/5 – 2009/10 in two of these sectors including a high alert at Goxhill Marsh (Ross-Smith *et al.* 2013) UK/Region trends: Mallard has been decreasing at a regional level in the long term and at a British level in the medium term. The proportion of Mallards from the region that overwinter on the Humber SPA is slightly lower than during the 1970s and 1980s, but has remained relatively stable during the 1990s and 2000s in spite of the declines on site (Cook *et al.* 2013).
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=435** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob1860.htm**
GENERAL ECOLOGY	DIET: Omnivorous, including both plants and animal matter (Kear 2005b) HABITAT: All wetland types, though prefers sites with shallow water and cover. Will feed and roost on the sea and in brackish waters (Kear 2005b) BEHAVIOUR: Feeds predominantly by dabbling in shallows, or upending in slightly deeper water. May also feed ashore and occasionally graze. Usually feeds in morning or evening, but may also feed at night (Kear 2005b). SENSITIVITY TO DISTURBANCE: Often tolerant of humans (Kear 2005b).
LOCAL ECOLOGY	Mallard occurs throughout the estuary, with the highest numbers recorded during WeBS low tides counts on the River Ouse east of Goole (Calbrade 2013). Cherry Cobb Sands was also important, with a mean peak count of more than 20% of the mean peak count for the Humber SPA over the period 2004/5 to 2009/10 (Ross-Smith *et al.* 2013). The area around the outfall at New Holland is also a favoured area where the birds feed on grain spill from the dock (Mander & Cutts 2005; Calbrade 2013).
ORIGIN	Many breeding populations are sedentary or only move in severe weather. However some populations are migratory and up to three-quarters of the birds wintering in the UK may be winter visitors from north-west Europe (Wernham *et al.* 2002). Many Mallards are released in the UK for wildfowling purposes; but numbers released on the inner Humber Estuary are considered to have declined.

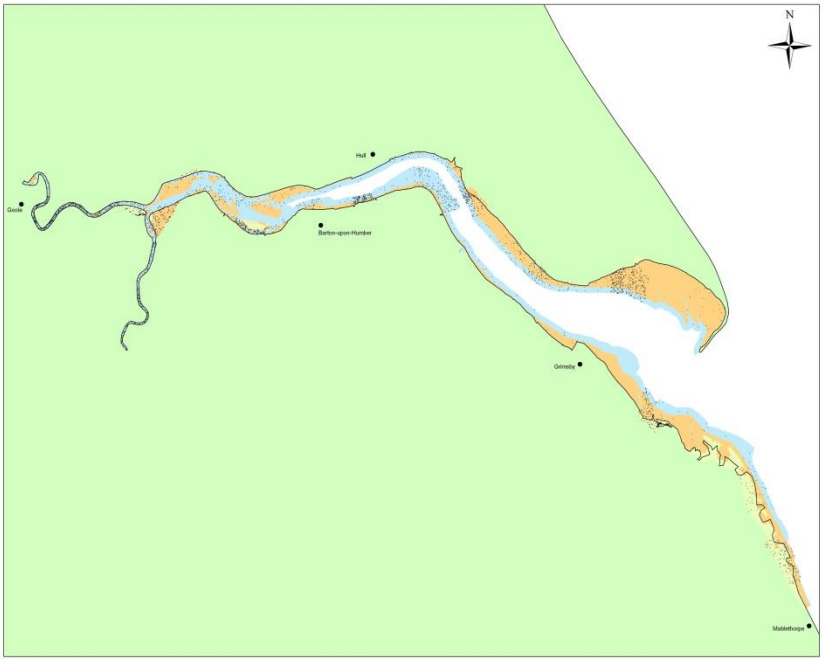
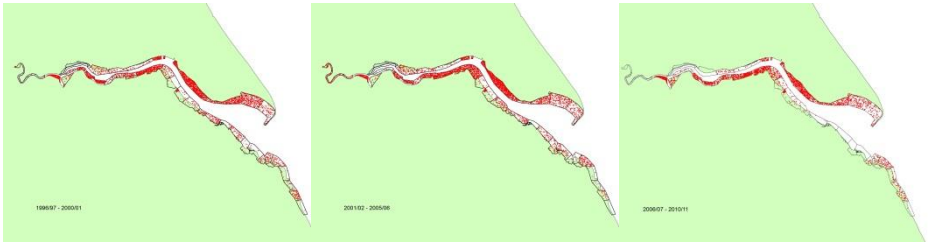
REASONS FOR DECLINE	SITE SPECIFIC: The contrast between site trends and regional and UK trends suggests that the decline results from broad-scale trends rather than site-specific trends (Cook *et al.* 2013). There has been a decline in the amount of grain spillage and subsequent availability of food at New Holland in recent years (G. Catley, pers. comm.). OTHER: The decline in the wintering population in the UK is thought to be caused by a reduction in long distance movement by European Mallards, perhaps because of milder winters in mainland Europe (Sauter *et al.* 2010). Disturbance may also potentially be having an effect in some sectors of the Humber.
POTENTIAL THREATS	Wetland habitat loss and degradation (Birdlife 2014). Wider influences have affected Mallard populations but site pressures may contribute to local declines.
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.   Relative distribution within The Humber relatively stable over the three periods though there has been a decline on the Lincolnshire coast in the most recent period.

Table 8. POCHARD (*Aythya ferina*)

POPULATION ESTIMATES (HUMBER)	AT CLASSIFICATION: **719** wintering (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **208** (Austin *et al.* 2014)
TRENDS (HUMBER)	Short-term trend: -41% Medium-term trend: -12% Long-term trend: +10% Sector trends: Increases occurred between 1994/5 and 2009/10 at Brough Haven to North Ferriby, Barton to Chower Ness (Inner Humber) and Barrow to Barton including Barton Pits (middle Humber), though medium alerts were raised for 2004/5 to 2009/10 for the first and last of these sectors. Declines have occurred in all other sectors for which trends are available including high alerts for all three timescales at Goxhill to New Holland, one of the most important sectors for Pochard (Ross-Smith *et al.* 2013) UK/Region trends: Numbers of Pochard wintering in the region and in Britain have been declining in the medium term. Numbers on the Humber SPA have fluctuated making it difficult to interpret site trends in comparison to regional trends.
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=472** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob1980.htm**
GENERAL ECOLOGY	DIET: Omnivorous, mainly plant material but also aquatic invertebrates and other small animals (Birdlife 2014). By sewage outfalls, often takes abundant Tubifex spp and other species (Galhoff 1987 in Kear 2005b) HABITAT: Extensive open water less than 6m deep with abundant submerged food. Usually prefers freshwater, but will switch to coastal waters in cold weather (Birdlife 2014) or when sewage outfall means food is abundant. Safe daytime roosts may be far from feeding sites (Kear 2005b). BEHAVIOUR: Feeds by diving, and often feeds by night in winter, roosting during the day (Kear 2005b). Males and females often use different habitats in winter and may occur in separate flocks, with the males said to feed in deeper areas than females (Kear 2005b) SENSITIVITY TO DISTURBANCE: Believed to be sensitive to disturbance, especially hunting (Meile 1991 in Kear 2005b) and waterborne recreation (Fox *et al.* 1994).
ECOLOGY (HUMBER)	The most important sectors for this species are at Barton to Chowder Ness, Barrow to Barton including Barton Pits and Goxhill to New Holland which between them held over 60% of the population over five winters 2004/5 - 2009/10 (Ross-Smith *et al.* 2013) A distribution model produced for Pochard on the Humber identified six environmental variables as predictors of distribution in estuarine areas, explaining 74% of density data variability. The relationship between intertidal and marsh areas was important, with the species most likely to be found where the intertidal area is <10 km^2, but where there is a wider marsh area (>0.84

	km^2) (Franco *et al.* 2013).
ORIGIN	Populations in western Europe are largely sedentary, but the small British population is supplemented in winter by significant numbers from the Baltic countries and Russia, and numbers may increase further if severe winter weather occurs in European wintering areas
REASONS FOR DECLINE	SITE SPECIFIC: The difference to the regional and national trends suggests site-specific factors may be affecting Pochard. However, numbers peaked strongly in the mid-1990s (reasons unclear), and were three times previous levels, which disproportionately affect the assessment of site trends. Pochards have generally been present in low numbers on the Humber and similar to current levels (Cook *et al.* 2013). Sewage treatment and subsequent reductions in related food resources have been implicated in declines of Pochard (Fox & Salmon 1988) and is therefore a possible cause of decline on the Humber. Although not likely to be the primary food resource of Pochard, there has been a decline in the amount of grain spillage and subsequent availability of food to waterfowl at New Holland in recent years (G. Catley, pers. comm.). Broad scale changes to wintering distribution within Europe may also have occurred (Maclean *et al.* 2006).
POTENTIAL THREATS	In Europe threats include disturbance from hunting and recreation, and damage to habitat caused directly and by eutrophication (Kear 2005b; Birdlife 2014).
DISTRIBUTION WITHIN THE HUMBER	Maps are not included for diving wildfowl as these were not included in Ross-Smith *et al.* (2013) or by WeBS Low Tide Counts.

Table 9. SCAUP (*Aythya marila*)

POPULATION ESTIMATES (HUMBER)	AT CLASSIFICATION: **127** wintering (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **80*** (Austin *et al.* 2014)
TRENDS	Site trends not available as this species is not included in WeBS Alerts due to insufficient data. Both population estimates substantially misrepresent numbers wintering annually in the SPA, with the high mean at classification due to a flock of 594 seen in 1996/97, and the most recent mean due to a flock of 236 during the low tide counts in 2011/12, thought to have been displaced from the continent by hard weather (Calbrade 2013). Scaup have all but vanished as a regular species on the Humber with only single figures recorded on Core Counts in the last five years. Sector trends not available as this species was not included in Ross-Smith *et al.* (2013). Regional trend comparison: not considered for WeBS Alerts.
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=482** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob2040.htm**
GENERAL ECOLOGY	DIET: Omnivorous, but mostly molluscs in winter, especially mussels *Mytilus spp*. Also cockles *Cardium spp.* and clams *Macoma spp* in estuaries and *Hydrobia spp*. in brackish waters (Kear 2005b) HABITAT: Winters in coastal waters, e.g. estuaries, feeding in shallow waters (Kear 2005b). BEHAVIOUR: Highly gregarious outside breeding season (Kear 2005b), feeding in large and small flocks (Madge & Burn 1988 in Birdlife 2014). SENSITIVITY TO DISTURBANCE: Unknown.
ECOLOGY (HUMBER)	No specific information available.
ORIGIN	Birds wintering in Britain & Ireland come from across the range of the nominate race (Iceland, the Baltic and east to beyond the Urals (Wernham *et al.* 2002)
REASONS FOR DECLINE	Unknown. Sewage treatment and subsequent reductions in related food resources have been implicated in declines of Scaup (Campbell 1984) and is therefore a possible cause of decline on the Humber. Although not likely to be the primary food resource of Scaup, there has been a decline in the amount of grain spillage and subsequent availability of food to waterfowl at New Holland in recent years (G. Catley, pers. comm.).
POTENTIAL THREATS	General threats include pollution, hunting and disturbance among others (Birdlife 2014).
DISTRIBUTION WITHIN THE HUMBER	Maps are not included for diving wildfowl as these were not included in Ross-Smith *et al.* (2013) or by WeBS Low Tide Counts.

Table 10. GOLDENEYE (*Bucephala clangula*)

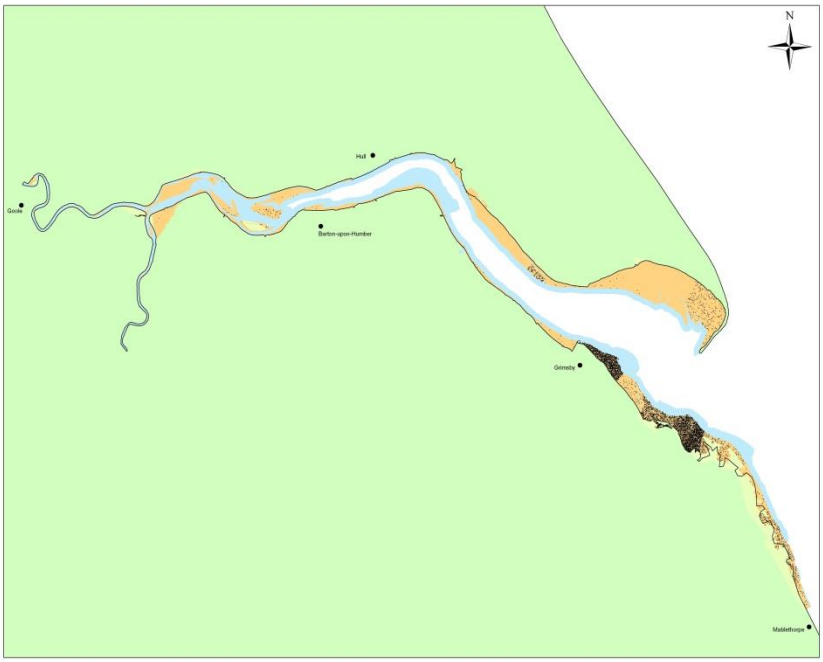
POPULATION ESTIMATES	AT CLASSIFICATION: **467** wintering (1.5% of the north-western European population, 1996/7 to 2000/1) (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **499*** (Austin *et al.* 2014)
TRENDS	Short-term trend: +261% Medium-term trend: -28% Long-term trend: -32% Sector trends: In the middle Humber, a medium alert was raised for all three timescales at Goxhill to New Holland, the most important sector for the species, and a high alert was raised at Goxhill Marsh. In Inner Humber, numbers decreased at Blacktoft Sands but increased at Brough Haven to Ferriby (Ross-Smith *et al.* 2013) UK/Region trends: The medium term declines observed on the Humber SPA appears to be matching the British trend, though not the regional trend. The importance of the Humber SPA on a regional scale is increasing, and a greater proportion of regional numbers are using the site.
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=494** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob2180.htm**
GENERAL ECOLOGY	DIET: Mostly aquatic insects, molluscs and crustaceans. Occasional fish. Plant material generally less than 25% (Kear 2005b). HABITAT: Mainly shallow estuaries, bays and harbours; also larger lakes and rivers (Kear 2005b) and in the vicinity of sewage outfalls (del Hoyo *et al.* 1992). BEHAVIOUR: Principally a diurnal feeder (Palmer 1976 in Kear 2005b). Feeds by diving. SENSITIVITY TO DISTURBANCE: Unknown
ECOLOGY (HUMBER)	The most important sectors for this species are Goxhill to New Holland which held over 20% of the birds in the Humber SPA over the period 2004/5 to 2009/10, and Barrow to Barton (including Barton Pits), which held between 10% and 20% (Ross-Smith *et al.* 2013).
ORIGIN	A small number of birds nest in the north of the UK but the vast majority of birds wintering in the UK are thought to come mainly from Fennoscandia and western Russia (Wernham *et al.* 2002).
REASONS FOR DECLINE	Flyway scale distribution shifts, in response to climate change, have been demonstrated for this species (Lehikoinen *et al.* 2013). The site trend is similar to the British trend but does not appear to be tracking that of the region, and the proportion of regional numbers is increasing suggesting that the site is becoming more important regionally (Cook *et al.* 2013). Improvements to sewage treatment and the subsequent reduction in related invertebrate food resources has been implicated in declines of Goldeneye at other sites (Fox & Salmon 1988, Maclean *et al.* 2006), and therefore represents a possible cause of decline on the Humber.

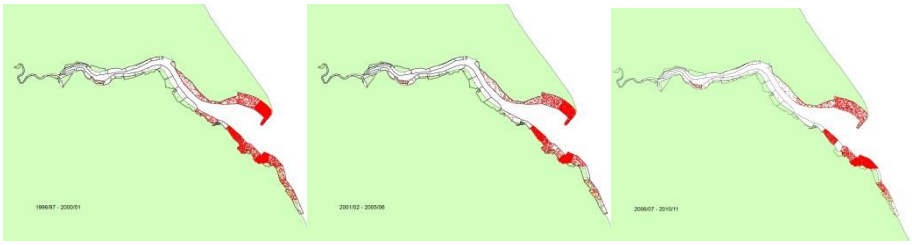
POTENTIAL THREATS	This species nests in tree cavities and the availability of cavities across its breeding range is thought to be a concern, as a result of changes in forestry practices (Kear 2005b). The Goldeneye flock on the Humber is almost entirely dependent on grain and animal foodstuffs spilt into the estuary as they are unloaded on the New Holland Pier; without this input the birds would probably not be there. The flock drifts downstream on a falling tide as far as North Killingholme and could therefore be susceptible to pollution incidents further downstream from where they feed (G. Catley, pers. comm.).
DISTRIBUTION WITHIN THE HUMBER	Maps are not included for diving wildfowl as these were not included in Ross-Smith *et al.* (2013) or by WeBS Low Tide Counts.

Table 11. OYSTERCATCHER (*Haematopus ostralegus*)

POPULATION ESTIMATES (HUMBER)	AT CLASSIFICATION: **3,503** wintering (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **4,881*** (Austin *et al.* 2014)
TRENDS (HUMBER)	Short-term trend: +4% Medium-term trend: -21% Long-term trend: -13% Sector trends: Trends are variable, but alerts have been triggered for at least one time period in all five sectors on the northern shore for which trends are available, and for all three timescales at Brough Haven to North Ferriby (Inner Humber), Cherry Cobb Sands (Middle Humber) and Spurn Head (Outer North). Trends for Outer Humber South are more variable, with decreases in the sectors near Cleethorpes, at Donna Nook, and in the sectors near Theddlethorpe, offset by increases in the sectors either side of Horseshoe Point, at Saltfleet, and at Somercoates to Donna Nook (Ross-Smith *et al.* 2013) UK/Region trends: The trend on the Humber SPA has remained relatively stable and in line with the national trend. The proportion of birds within the region using the site has also remained relatively stable (Cook *et al.* 2013)
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3088** BTO FACTS: **http://blx1.bto.org/birdfacts/results/bob4500.htm**
GENERAL ECOLOGY	DIET: Predominantly shellfish, especially large cockles *Cerastoderma edule* and mussels *Mytilus edulis* (Delany *et al.* 2009) and tellins *Macoma* spp. (BTO 2014). May also include ragworms *Nereis* spp. and Lugworms *Arenicola* spp. on mudflats and earthworms from wet fields (Hulscher 1996). HABITAT: Feeds mostly on shellfish beds on inter-tidal mudflats, using nearby mixed wader roost sites when feeding areas are covered by tides (e.g. Rehfisch *et al.* 1996). Some birds may also feed on earthworms in adjacent wet fields at high tide if they have been unable to find sufficient food when the mudflats are uncovered (Caldow *et al.* 1999 in Delany *et al.* 2009). BEHAVIOUR: Individual Oystercatchers often specialise on one prey species for extended periods and from one winter to the next, and have different bill shapes and different techniques for opening shells. Birds can respond to environmental conditions by changing bill shape, though there is a time delay of 10-20 days before the bill changes to the optimum shape for a different prey species (Sutherland *et al.* 1996). Prey is detected by both sight and touch and birds can feed by day and night, with most of the winter studies listed in Hulscher 1996 showing *c.*2/3 of food intake occurring during the day. Many Oystercatchers are very site faithful, returning to the same wintering site and feeding on the same shellfish beds, though others roam over a wider area (Ens & Cayford 1996). Though they are not strictly territorial, dominance interactions create a dispersed feeding pattern (Colwell, 2010). As a result, less dominant birds including young birds may be unable to feed on mussel beds

	and may be forced to feed on other food items and on fields (Ens & Crayford 1996) SENSITIVITY TO DISTURBANCE: Several studies suggest that Oystercatcher is less sensitive to disturbance than other species, allowing a closer approach and showing habituation to recreational activity and construction work (e.g. various in Cutts & Allen 1999; Davidson & Rothwell 1993; Cutts *et al* 2009).
LOCAL ECOLOGY	Found almost exclusively in the outer estuary. The most important areas for Oystercatcher are along the Lincolnshire coast in the Outer South area (Calbrade 2013), in particular Horseshoe Point to Humberston Fitties, Grainthorpe Haven Pye's Hall to Horseshoe Point and Somercoates to Donna Nook (Ross-Smith *et al.* 2013). Disturbance: In a sensitivity analysis for the Humber, defined as Moderate to Low sensitivity as shows habituation (Cutts *et al* 2009).
ORIGIN	Some birds wintering on the east coast of England come from further north in the UK. Large numbers also come from abroad in including Scandinavia, the Faroes, Iceland and north-west Europe (Wernham *et al.* 2002)
REASONS FOR DECLINE	SITE SPECIFIC: The site trend is tracking the regional trend though not the British trend. The fluctuating, yet relatively stable, proportion of regional numbers does not suggest a site-specific issue (Cook *et al.* 2013). OTHER: Distribution shifts of seven wader species towards the north-east over the period 1981-2000, including Oystercatcher, was attributed to greater numbers wintering in north-east Europe as a result of climate change, though this may be caused by range expansion and changes in juvenile settlement rather than movement by individual birds (Maclean *et al.* 2008).
THREATS	The main threat is deterioration of the habitat and/or shellfish beds to such an extent that the major kills observed during the 1990s are repeated. Survival models have predicted that in order to maintain Oystercatcher populations, the volume of bivalves available in autumn needs to be 2.5-8 times the amount they will consume during the winter. This is because intraspecific competition increases when food supplies are low and sub-dominant birds are excluded from much of the food supply (Goss-Custard *et al.* 2004).
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.





Relative distribution within The Humber relatively stable over the three periods.

Table 12. RINGED PLOVER (*Charadrius hiaticula*)

POPULATION ESTIMATES	AT CLASSIFICATION: **403** wintering , 1766 passage (JNCC 2014) WeBS 5-year peak mean as of 2012/13: 1433 (passage).
TRENDS	Short-term trend: -53% Medium-term trend: -69% Long-term trend: -64% Sector trends: Increases occurred over all three time periods at Cherry Cobb Sands (Middle Humber) and at Grainthorpe Haven's Pye Hall to Horseshoe Point (Outer South). Otherwise, alerts were triggered for at least one time period in all sectors for which trends were available for Ringed Plover, though a subsequent short-term increase did occur in the North Ferriby to Hessle Haven sector (Inner Humber) (Ross-Smith *et al.* 2013) UK/Region trends: Numbers of wintering Ringed Plovers have been declining both within the region and within Britain. However, the number of Ringed Plovers using the Humber SPA is declining both as a proportion of the region and as a proportion of the numbers wintering in Britain (Cook *et al.* 2013).
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3116** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob4700.htm**
GENERAL ECOLOGY	DIET: In winter, mainly marine worms, crustaceans and molluscs (BTO 2014). HABITAT: Predominantly sand and shingle shores, sandbanks and mudflats, roosting close to the feeding sites on bare ground and in low vegetation (Delany *et al.* 2009) BEHAVIOUR: Can occur in large flocks in winter. Feeds by sight using pause/travel approach like other plovers. SENSITIVITY TO DISTURBANCE: Unknown for wintering population
LOCAL ECOLOGY	The most important sectors for Ringed Plover are the two sectors either side of Horseshoe Point, and Cleethorpes – North Promenade to Anthony's Point (Ross-Smith *et al.* 2013). Wintering numbers were low during the 2011/12 WeBS low tide counts with the highest count occurring at East Halton to Goxhill Haven (Middle Humber). A substantial spring passage occurred with peak counts of over 400 birds at Donna Nook (Outer South) and Cherry Cobb Sands (Middle Humber) (Calbrade 2013).
ORIGIN	Dispersal during the non-breeding season is complex and poorly understood. Some passage and wintering birds probably originate from breeding areas further north in the UK, others from breeding populations around the North Sea. Birds from Fennoscandia, Iceland and Greenland probably occur mainly on passage (Wernham *et al.* 2002).

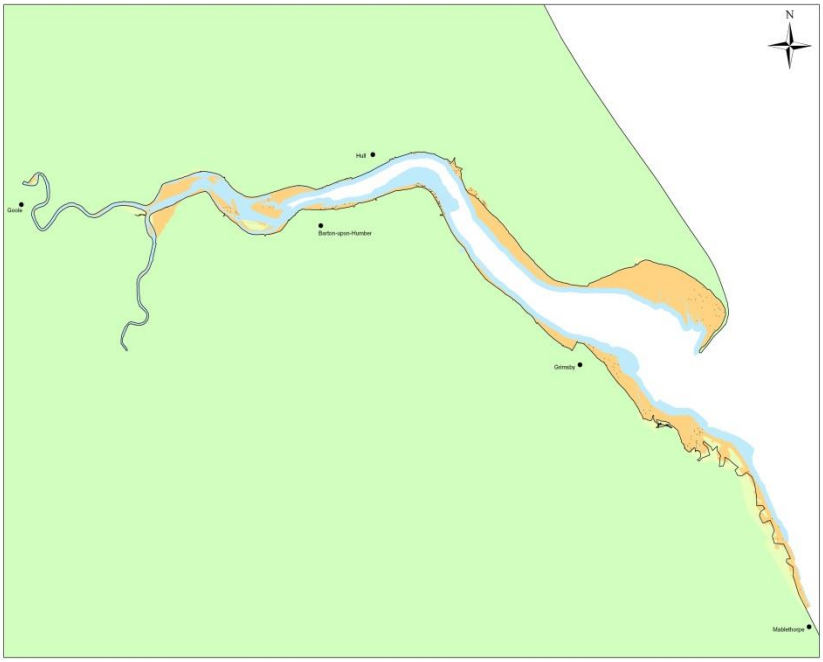
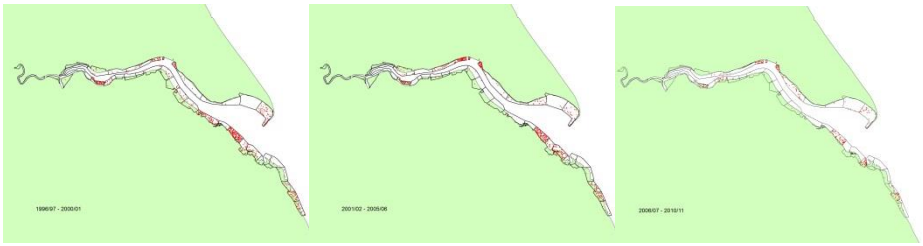
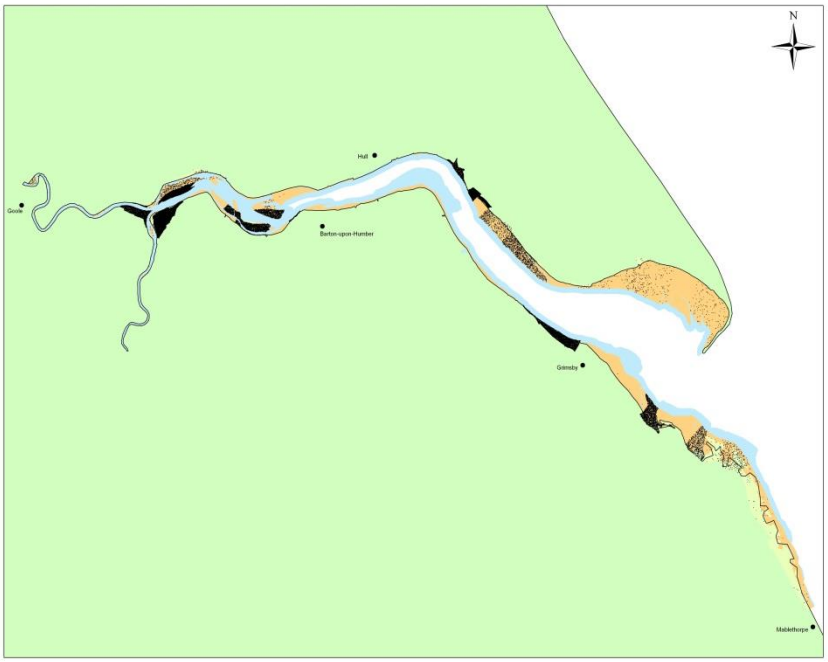
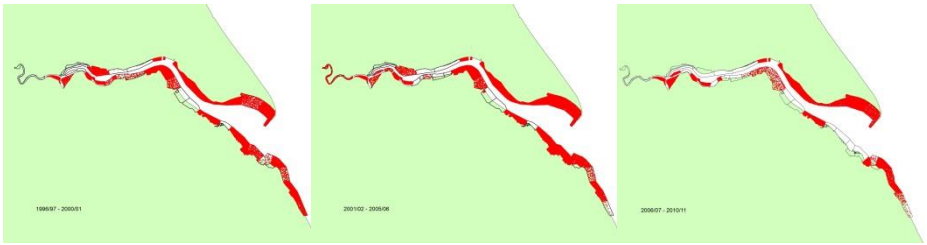
REASONS FOR DECLINE	The declining proportion of Ringed Plovers using the site suggests that unknown site-specific factors are affecting the Humber SPA (Cook *et al.* 2013). This will exaggerate the rate of decline on the Humber. Breeding population (Liley & Sutherland 2007, Prater 1989, Jackson & Green 2000) and wintering population are both declining in the UK. However the precise relationship between the two decreases is unclear and difficult to quantify.
THREATS	Disturbance at breeding sites, as well as potential disturbance at passage sites and overwintering areas.
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.   Relative distribution within The Humber relatively stable over the three periods though there has been a decline in number throughout the site in the most recent period.

Table 13. GOLDEN PLOVER (*Pluvialis apricaria*)

POPULATION ESTIMATES	AT CLASSIFICATION: **30,709** wintering (12.3% of the GB population, 1996/7 to 2000/1) (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **25,852**** (Austin *et al.* 2014)
TRENDS	Short-term trend: -45% Medium-term trend: -13% Long-term trend: +342% Sector trends: Declines were noted in the majority of sectors, with notable exceptions at Alkborough Flats (Inner Humber) and Patrington to Easington (Outer Humber North) where increases occurred over all three time periods, and at Donna Nook (Outer Humber South), where increases occurred in both the short and medium term despite the site declines (Ross-Smith *et al.* 2013). UK/Region trends: Numbers of wintering Golden Plover have declined in the short term following a peak in the mid-2000s, both at a regional scale and in Britain as a whole. The proportion of Golden Plovers using the Humber SPA has remained relatively stable during this period (Cook *et al.* 2013).
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3111** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob4850.htm**
GENERAL ECOLOGY	DIET: Mainly insects, especially beetles; also other invertebrates and some plant material (Birdlife 2014). HABITAT: Feeds mainly on pasture and arable farmland in winter (Delany *et al.* 2009). Mudflats and saltmarshes are mainly used for roosting (Delany *et al.* 2009). Golden Plovers prefer larger fields with a vegetation height of 7-13 cm in grass fields, and avoid cereal fields with vegetation height above 9 cm (MacDonald 2009). A detailed summary of habitat requirements for this species is given in MacDonald 2009, pp7-9. BEHAVIOUR: Birds forage by day and by night, returning to favoured sites in subsequent years (Byrkjedal & Thompson 1998 in Delany *et al.* 2009). SENSITIVITY TO DISTURBANCE: There is some evidence that wintering Golden Plover can be more tolerant to disturbance events than other waders, with flight distances of c.50 m compared to almost 100 m for Redshank and Curlew (Smit & Visser 1993). However sensitivity increases during passage periods. The species may also be at risk from displacement as a result of onshore windfarms situated in agricultural fields.
ECOLOGY (HUMBER)	Golden Plover mainly uses the estuary to roost in nine key areas: Alkborough Flats, Whitton Sands, Blacktoft Sands, Read's Island (all Inner Humber) Salt End, Stone Creek, Paull Holme Stray, Cherry Cobb Sands and Pyewipe (all Middle Humber) (Calbrade 2013).

	Behaviour on the Humber generally matches that observed elsewhere, with birds mainly feeding inland and using the estuary for roosting (Cutts *et al.*, 2009; MacDonald 2009), though some birds were observed roosting in fields within the South Humber Bank Zone (ABPMer 2005 in MacDonald 2009). Sensitivity at roost at Saltend was found to be high during passage, possibly due to lack of habituation to disturbance (Cutts & Allen 1999). In a sensitivity analysis specific to the Humber, Golden Plover was defined as High risk as is susceptible in severe weather, present in internationally important numbers, and uses inland fields for feeding (Cutts *et al.* 2009). A distribution model for Golden Plover on the Humber produced six environmental variables as predictors of distribution, explaining 96% of density data variability (Franco *et al.* 2013), though the analysis was for estuarine areas so does not take account of the use of fields outside the SPA boundary. Higher densities are predicted where subtidal area in the sectors is <10 km^2 and marsh area is >0.6 km^2. As marsh area is positively correlated with intertidal area in the estuary, higher densities will also occur where there are larger intertidal mudflats, and the type of substratum (in particular littoral sands) is also important (Franco *et al.* 2013).
ORIGIN	Two subspecies occur in the UK in winter. *Apricaria* breeds in western Europe including the UK and is only a short distance migrant (Delany *et al.* 2009). *Altifrons* is a long distance migrant and 75% of *altifrons* wintering in the UK are thought to be from Iceland (Byrkjedal & Thompson 1998, in Delany *et al.* 2009).
REASONS FOR DECLINE	Caution is necessary when interpreting WeBS-based trends for Golden Plover, but the site trend appears to be tracking the regional and British trends with a short term decline after previously peaking. The similarity between site and regional/British trends suggests that the recent decline results from broad-scale population trends for this species (Cook *et al.* 2013). However, Gillings *et al.* (2006) showed an easterly shift in distribution across Britain, so all else being equal the Humber might be expected to be performing better than other UK sites. A reduction in the mudflat area and/or steepening of the mudflat may affect this species as it uses large intertidal areas for roosting (Cutts *et al.* 2012). OTHER: Numbers of *altifrons* wintering in Europe are decreasing, and there has also been a long-term decline in breeding *apricaria* (Delany *et al.* 2009).
POTENTIAL THREATS	This species is particularly susceptible to severe weather conditions (Birdlife 2014). A study in Essex suggested that rapid growth of autumn sown cereal may affect numbers if warm dry autumns become more common. When crop height in arable fields becomes too high birds may be forced to leave the area or forage on intertidal habitat (Mason & MacDonald 1999). Golden Plover may also be displaced by onshore windfarms.
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.



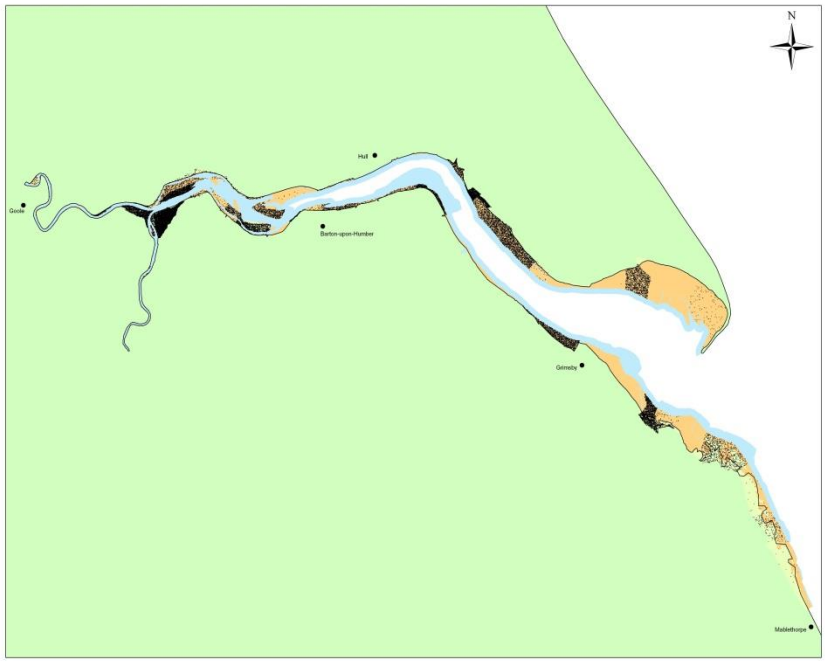


Relative distribution within The Humber relatively stable over the three periods though there has been a decline on the Lincolnshire coast in the most recent period.

Table 14. LAPWING (*Vanellus vanellus*)

POPULATION ESTIMATES	AT CLASSIFICATION: 22,765 wintering (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **10,746*** (Austin *et al.* 2014)
TRENDS (HUMBER)	Short-term trend: -49% Medium-term trend: -42% Long-term trend: +108% Sector trends: Declines in Lapwing numbers have occurred in at least one time period for almost all sectors where trends have been reported. The only exceptions are Alkborough Flats, Sector B1 and Barton Cliffs (all Inner Humber) and Theddlethorpe to Mablethorpe North End (Outer South) UK/Region trends: Numbers of wintering Lapwing have been decreasing in the short term within the region and in the medium term in Britain following previous declines. However, the proportion of Lapwings wintering within the region that use the Humber SPA declined during the 1990s (Cook *et al.* 2013)
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3153** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob4930.htm**
GENERAL ECOLOGY	DIET: Wide range of invertebrates including beetles and earthworms (Shrubb 2007; Birdlife 2014). HABITAT: Feeds mainly on pasture, wet meadows and arable farmland in winter (Delany *et al.* 2009). Prefers fields with a preferred vegetation height of c.7cm in grass fields, and 7-11cm in arable fields (MacDonald 2009). Larger fields may be preferred, but evidence is contradictory and an open boundary may be more important (Shrubb 2007). Roosts in large open fields with ploughed soil or tussocky grassland for concealment (Shrubb 2007). A detailed summary of habitat requirements for this species is given in MacDonald 2009, pp9-10. Use of estuarine sites can become important in cold weather when other sites freeze, and flocks may move long distances at the onset of severe weathers (Delany *et al.* 2009). BEHAVIOUR: Lapwings feed by sight using a pause/travel approach (pausing to look for prey then walking a few steps and pausing again). They have large eyes and so can feed at night, especially during brighter nights. During mild weather and when there is a full moon, they tend to feed at night and roost by day. Feeding birds spread out more widely across fields when less prey is available, e.g. during frosty conditions (Shrubb 2007) SENSITIVITY TO DISTURBANCE: Cutts *et al.* (2009) consider this species be relatively tolerant to disturbance compared to other species.

LOCAL ECOLOGY	Lapwing mainly uses the estuary to roost in nine key areas: Alkborough Flats, Whitton Sands, Blacktoft Sands, Read's Island (all Inner Humber) Salt End, Stone Creek, Paull Holme Stray, Cherry Cobb Sands and Pyewipe (all Middle Humber) (Calbrade 2013). The Inner Humber estuary is a key area for Lapwing, with the majority of feeding occurring inland, though some feeding on intertidal areas takes place during July to September (Catley 2000 in MacDonald 2009). Baylis (2013) categorised the wildfowling influence at Alkborough Flats as 'Moderate to High' though this is based on a qualitative assessment of the areas used by Lapwings, rather than a quantitative measure. Beriro & Goodall (2007) produced a detailed map of inland feeding sites in NE Lincolnshire.
ORIGIN	The Lapwings breeding in the south-west of the range (which includes the UK) are resident or partial migrants apart from in severe weather (Delany *et al.*, 2009). However, the majority of wintering birds in the UK are from elsewhere, with birds in the east thought to come from Scandinavia (Wernham *et al.* 2002)
REASONS FOR DECLINE	SITE SPECIFIC (Humber): The site trend appears to be tracking the regional and British trends - a short term decline after previously peaking in the early/mid 1990s. The proportion of regional and UK birds using Humber Estuary SPA is decreasing suggesting that the reason for the short and medium-term decline may be site-specific (Cook *et al.* 2013). Steep declines in western Europe, including a decline of 42% in the UK breeding population over the period 1995-2012 (Harris *et al.* 2014), have been linked to agricultural intensification (Wilson *et al.* 2001, Beintema *et al.* 1995 in Delany *et al.* 2009). A distributional shift in wintering Lapwing in the UK occurred between 1974/5 and 2002/3, leading to a marked increase in numbers wintering on the east coast and explaining the peak in numbers at this time on site and within the region (Gillings *et al.* 2006). There is no more recent evidence.
THREATS	The main threat is thought to be changes to breeding habitats, but stopover sites may also be affected by pollution and drainage (Birdlife 2014).A study in Essex suggested that rapid growth of autumn sown cereal may affect numbers if warm dry autumns become more common. When crop height in arable fields becomes too high birds may be forced to leave the area or forage on intertidal habitat (Mason & MacDonald 1999).
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.

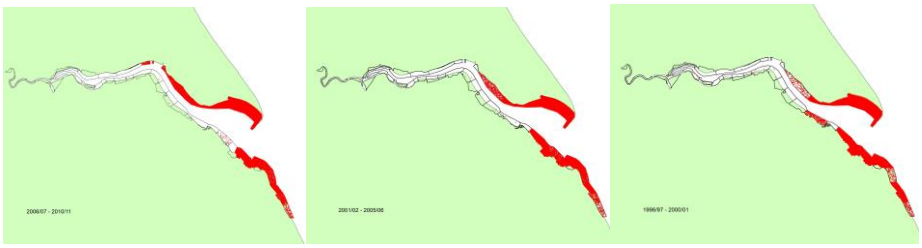


Relative distribution within The Humber relatively stable over the three periods though there was a marked drop in the middle period, possibly due to a succession of mild winters.

Table 15. KNOT (*Calidris canutus*)

POPULATION ESTIMATES	**AT CLASSIFICATION:** 18,500 on passage (4.1% of the north-eastern Canada/Greenland/Iceland/north-western European population, 1996/7 to 2000/1); 28,165 wintering (6.3% of the north-eastern Canada/Greenland/Iceland/north-western European population, 1996/7 to 2000/1) (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **14,090**** (Austin *et al.* 2014)
TRENDS	Short-term trend: -8% Medium-term trend: +15% Long-term trend: +18% Sector trends: In the Outer North area, alerts have been triggered at Spurn Head, but increases have occurred in the other two sectors and also at the adjacent Cherry Cobb Sands sector (Middle Humber). In the Outer South area, trends have been mixed. Increases over 10 and 15 years at both Donna Nook and Grainthorpe Haven Pye's Hall to Horseshoe Point have been followed by a medium alert for the short term period 2004/5 to 2009/10. Short-term increases have occurred in the two sectors either side of Theddlethorpe, but at least one alert has been triggered in all the other Outer South sectors for which trends are available (Ross-Smith *et al.* 2013). UK/Region trends: The trends for Knot for the region and for Britain have remained relatively stable in the long term. The proportion of regional numbers using the Humber SPA has also remained relatively stable (Cook *et al.* 2013)
LINKS	**BIRDLIFE: http://www.birdlife.org/datazone/speciesfactsheet.php?id=3041** **BTO BIRDFACTS: http://blx1.bto.org/birdfacts/results/bob4960.htm**
GENERAL ECOLOGY	DIET: Mainly molluscs, including tellins *Macoma balthica*, Mussels *Mytilus edulis*, Cockles *Cerastoderma edulis* and mudsnails *Hydrobia ulvae*, the latter especially in early winter (Zwarts *et al.*, 1992 & Piersma *et al.*, 1998 in Delany *et al.*, 2009). Atkinson *et al.* (2010), gives diet proportions after Leopold *et al.* 2004a,b, of 75% bivalves, 1% worms and 24% 'other'. Prey is eaten whole and crushed within the gizzard (Piersma 2006). HABITAT: Feed in dense flocks on extensive intertidal mudflats (Delany *et al.* 2009). Sometimes fly many kilometres to roost sites, along undisturbed shorelines, possibly in order to reduce predation risk (Piersma *et al.* 1993). Knots are apparently more reluctant than other wader species to roost inland (Black & Veatch 2008) BEHAVIOUR: Knots feed in very large flocks on open mudflats, catching food mainly by touch by making 'sewing movements' with their bill as they move forward (Piersma 1994), and may also detect prey by 'remote sense' (i.e. from vibrations rather than direct touch) (Piersma *et al.* 1994a). Flocks will move with the tide and cover may very extensive areas of mudflat, e.g. Knots covered most of the intertidal flats in the Dutch Wadden Sea in just a couple of tidal cycles (Piersma *et al.* 1994b).

	SENSITIVITY TO DISTURBANCE: Several studies indicate that this species is sensitive to disturbance, especially at roost sites (Pfister *et al.* 1992; Kirby *et al.* 1993; Burton *et al.* 1996).
LOCAL ECOLOGY	Knot is found in the Outer Humber, with the most important sectors being those in the Outer North area (Ross-Smith *et al.* 2013), and also Cherry Cobb Sands (Middle Humber) and the Lincolnshire coast south of Grimsby (Outer South) (Calbrade 2013). Easington Lagoons provide an important roost site for Knot during high spring tides. If this site is lost as a result of breaching, nearby fields may provide a roost site for other waders but Knots may vacate the estuary if other sites are not available as they are more reluctant to use fields (Black and Veatch 2008). Disturbance: In a sensitivity analysis for the Humber, defined as highly sensitive (Cutts *et al* 2009).
ORIGIN	Birds wintering in Britain are believed to be from the *islandica* race which breeds in Greenland and Arctic Canada. Around 65% of the *islandica* population are thought to be in Britain & Ireland in midwinter (Delany *et al.* 2009).
REASONS FOR DECLINE	The sites trend is relatively stable and mirrors the regional and British trends, suggesting that conditions remain relatively favourable for this species (Cook *et al.* 2013). There is evidence that an easterly shift in the wintering distribution of this species in Europe has occurred as a result of climate change (Maclean *et al.* 2008). Knots may also be sensitive to changing feeding conditions at a site. Quaintenne *et al.* (2011), suggested that Knots may be aware of potential food resources across western Europe, and may fly to a different area once or twice within the same winter (e.g. between the Wash and the Wadden Sea).
POTENTIAL THREATS	Threats include direct impacts such as shellfishing (Atkinson *et al.* 2010), disturbance, and habitat loss due to drainage and development (del Hoyo *et al.* 1996). They need extensive areas of mudflats, so they may also be more vulnerable than other species to changes to the extent of mudflat as a result of natural processes and indirect anthropogenic effects such as climate change and sea level rise. However, models by Stillman *et al.* (2005) did not predict reduced survival for Knot on the Humber if a 2-8% reduction in intertidal area occurred.
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.



Relative distribution within The Humber relatively stable over the three periods, though increasing on the Lincolnshire coast.

Table 16. SANDERLING (*Calidris alba*)

POPULATION ESTIMATES	AT CLASSIFICATION: 818 on passage; **486** wintering (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **595*** (Austin *et al.* 2014) [The 5-year mean is elevated by a high count of 1,194 in 2009/10]
TRENDS	Short-term trend: +11% Medium-term trend: -24% Long-term trend: -20% Sector trends are not available as this species was not included in Ross-Smith *et al.* (2013). UK/Region trends: Numbers of Sanderling have been increasing in the region in the long term, and in Britain in the short term after previously being stable. The proportion of regional numbers using the Humber SPA has declined since the 1990s.
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3042** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob4970.htm**
GENERAL ECOLOGY	DIET: Mainly invertebrates, including molluscs, polychaete worms, crustaceans and insects (Del Hoyo *et al*, 1996). Atkinson *et al.* (2010), give diet proportions after Leopold *et al.* 2004a,b, of 60% worms, 1% molluscs and 39% 'other'. HABITAT: Typically sandy beaches and sandbars away from estuaries (Balmer *et al.*, 2013). Uses roost sites with other wader species. BEHAVIOUR: Typically a bird of sandy beaches where it feeds along the shoreline. Gregarious, often occurring in large flocks and being highly site faithful (Delany *et al.* 2009) SENSITIVITY TO DISTURBANCE: Sensitive to disturbance from recreation on sandy beaches (Burger & Gochfeld, 1991 in Colwell 2010; Burger 2007,2004 in Colwell 2010; Birdlife 2014), particularly when greater numbers of people and/or free running dogs are present (Thomas *et al* 2003 in Cutts *et al* 2009).
LOCAL ECOLOGY	Within the Humber SPA, Sanderling are found exclusively in the outer estuary, mainly in the Outer South area on the sandy flats of the Lincolnshire coast (Calbrade 2013).
ORIGIN	Breeds in the Arctic, using a small number of stopover sites during migration (Del Hoyo *et al* 1996). UK birds are mainly from Siberia, with birds from Greenland thought to pass through on their way to Africa (Delany *et al.* 2009). However, ringing studies suggest that some Greenland birds may overwinter in the UK (Wernham *et al.* 2002; Reneerkens *et al.* 2009).
REASONS FOR DECLINE	The trend on site does not match either the regional or British trends, and the proportion of regional numbers supported on site suggests that the alert for this species may have been triggered by site specific pressures (Cook *et al.* 2013). This species is mainly found in the Outer South area, where the levels of recreational activity are high and therefore disturbance may be a factor.
THREATS	Disturbance (Birdlife 2014).

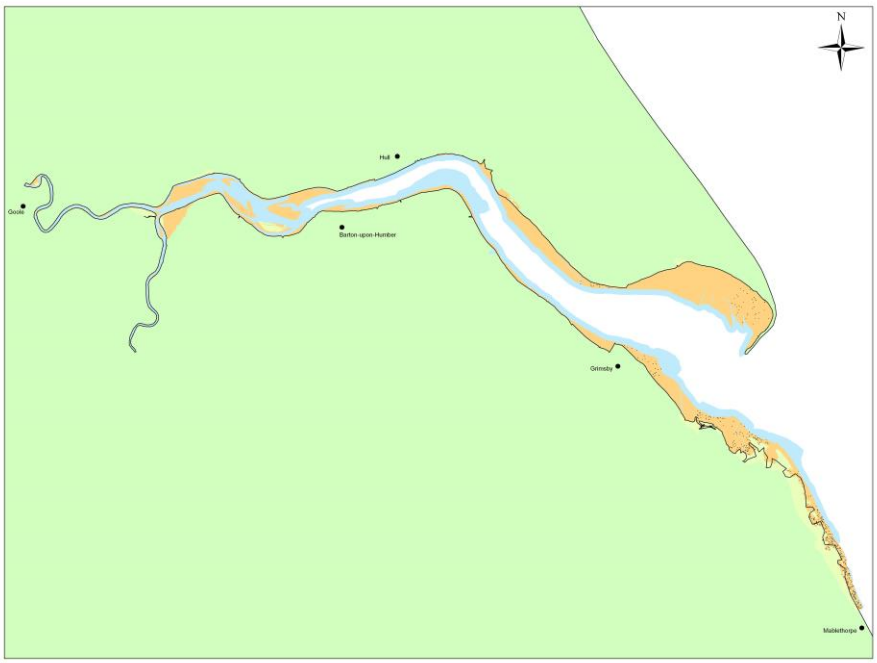
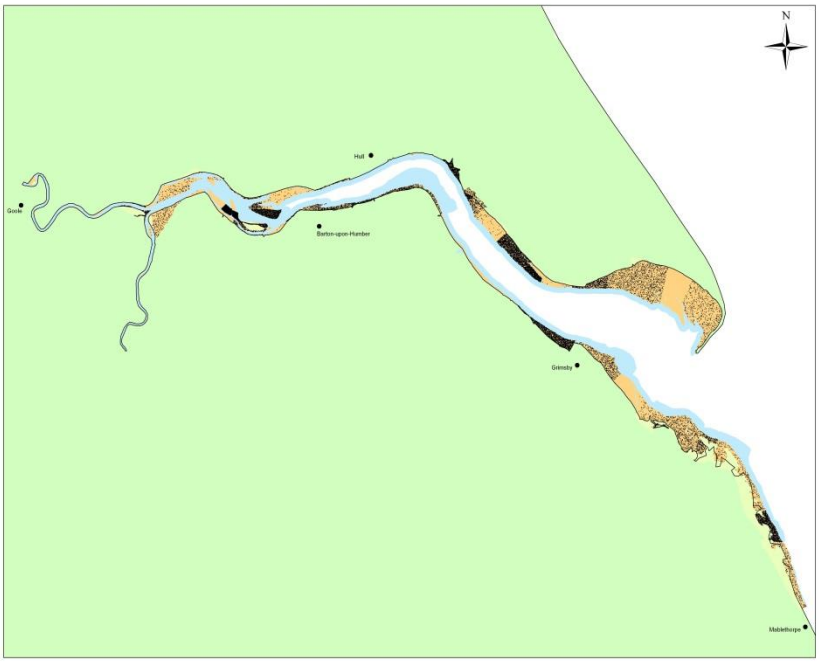
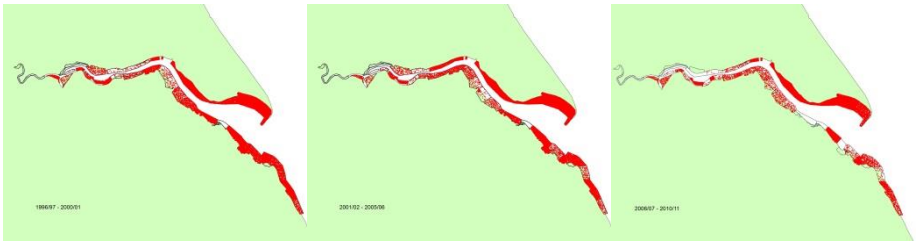
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.  Core Count distribution maps are not included for Sanderling as these were not included in Ross-Smith *et al.* (2013).

Table 17. DUNLIN (*Calidris alpina*)

POPULATION ESTIMATES	AT CLASSIFICATION: race *alpina* 20,269 on passage (1.5% of the northern Siberian/European/western African population, 1996/7 to 2000/1); 22,222 wintering (1.7% of the northern Siberian/European/western African population, 1996/7 to 2000/1) (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **14,090** wintering** (Austin *et al.* 2014)
TRENDS	Short-term trend: -7% Medium-term trend: -28% Long-term trend: -34% Sector trends: Sector trends for Dunlin are variable but decreases have occurred in most sectors especially in the Outer Humber (South). Exceptions include Alkborough Flats and Read's Island Flats (Inner Humber), New Holland to Barrow (Middle Humber), Stone Creek to Patrington and Patrington to Easington (Outer Humber North) (Ross-Smith *et al.* 2013) UK/Region trends: The number of Dunlin wintering in the region and in Britain has been declining in the medium term. The proportion of regional numbers using the Humber SPA has remained relatively stable during the period of decline (Cook *et al.* 2013)
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3056** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob5120.htm**
GENERAL ECOLOGY	DIET: Omnivorous, mainly polychaete worms and small gastropods during winter (Birdlife 2014). Atkinson *et al.* (2010), gives diet proportions after Leopold *et al.* 2004a,b, of 70% worms, 14% bivalves and 16% 'other'. HABITAT: Feeds on estuarine and non-estuarine intertidal mudflats (Delany *et al.* 2009). Joins wader roosts near feeding areas; will use open fields during highest tides (Delany *et al.* 2009; Shepherd and Lank 2004 in Birdlife 2014). BEHAVIOUR: Feeds by touch and sight by day and night according to tides, remaining in large flocks during winter (various in Birdlife 2014). Site faithful to winter roost sites both within and between winters (Clark 2002 in Delany *et al.* 2009). SENSITIVITY TO DISTURBANCE: Mixed: Kirby *et al.* 1993 found that it was one of the more commonly disturbed species at roost sites on the Dee, though Davidson & Rothwell (1993) did not include it among the more nervous species. Burton *et al.* (2002a) noted that it was the last species to fly when disturbed by walkers, though counts were still significantly lower at sites close to footpaths.
LOCAL ECOLOGY	The most important WeBS sectors for Dunlin during the core counts are in the Outer North area and also at Read's Island Flats (Inner Humber). They were widespread during 2011/12 low tide counts, with the highest numbers found at Read's Island (Inner Humber), Cherry Cobb Sands, Pyewipe, Stone Creek and Salt End (all Middle Humber) and Saltfleet (Outer South) (Calbrade 2013).

	A distribution model for Dunlin on the Humber produced four environmental variables as predictors of distribution in estuarine areas, explaining 85% of density data variability. A low density of Dunlin is expected when intertidal area within the sector is less than 1 km^2, with higher densities as the intertidal and subtidal areas increase. Similar models for the Weser and Elbe estuaries also included intertidal area as an important variable (Franco *et al.* 2013). Disturbance: At Saltend, the species showed a variable response to construction activity, sometimes being put up and flying a short distance, but often returning closer to the disturbance whilst feeding (Cutts *et al* 2009)
ORIGIN	Three forms found in the UK. *Artica* (Greenland/Iceland) only occurs on passage (Wernham *et al* 2002), and schinzii (UK/western Europe) winters mainly in Africa (Delany *et al.* 2009). The majority of wintering birds are *alpina* from northern Fennoscandia and European Russia (Wernham *et al.* 2002). Large congregations of alpina gather in the Wadden Sea in spring prior to migration, though some birds also gather in the Wash (Wernham *et al.* 2002).
REASONS FOR DECLINE	SITE SPECIFIC: The site trend is a medium term decrease having previously been stable, but the site trend appears to be tracking that of the region and British trends, and the proportion of both the regional and countrywide numbers supported by the site remains stable, suggesting that the declines are caused by broad-scale shifts in distribution rather than local pressures (Cook *et al.* 2013). OTHER: There is evidence that a north-easterly shift in the wintering distribution of this species has occurred in Europe in response to climate change, with the 'weighted centroid' for the distribution shifting from near the south coast of Britain towards the east coast (Maclean *et al.* 2008). This shift may lead to some birds remaining in mainland Europe during winter rather than wintering in the UK (Maclean *et al.* 2008), but may also lead to increased numbers remaining on the east coast of Britain rather than wintering in the south-west (Austin & Rehfisch 2005).
THREATS	Vulnerable due to their reliance on a relatively small number of sites where they occur in large numbers (e.g. the Wash and the Wadden Sea) (Birdlife 2014). The predicted reduction in intertidal mudflats on the Humber could be a threat for this species. However, Stillman (2005) does not predict decreased survival rates for Dunlin as a result of the predicted mudflat losses.
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.





Relative distribution within The Humber relatively stable over the three periods

Table 18. RUFF (*Philomachus pugnax*)

POPULATION ESTIMATES (HUMBER)	AT CLASSIFICATION: **128** on passage (1.4% of the population in GB) (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **49*** on passage (Aug) (Austin *et al.* 2014)
TRENDS	Site trends not available as this species is not included in WeBS alerts. Sector trends not available as this species was not included in Ross-Smith *et al.* (2013). Regional trend comparison: not considered for WeBS Alerts
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3062** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob5170.htm**
GENERAL ECOLOGY	DIET: Varied, including invertebrates (especially insects), and some plant material (especially seeds) (MacDonald 2009). HABITAT: Muddy margins of water bodies and mown or grazed grasslands (MacDonald 2009), intertidal habitats rarely used (Birdlife 2014). BEHAVIOUR: Often feed at night but with some crepuscular and day time activity (McNeil & Rodríguez 1996 in MacDonald 2009). There is evidence in the UK that wintering roosts are highly site faithful (Smart *et al.* 2002 in Delany *et al.* 2009). SENSITIVITY TO DISTURBANCE: Unknown.
ECOLOGY (HUMBER)	Primarily recorded during passage. Blacktoft Sands is a key site, but may occur widely around the estuary in suitable wetland or grassland habitat in autumn (MacDonald 2009)
ORIGIN	The main breeding areas are in Siberia, with most birds wintering in Africa and only a few in the UK (Delany *et al.* 2009)
THREATS	Unknown
REASONS FOR DECLINE	It is not known whether any site-specific factors may have occurred. However, there is some evidence of an eastward shift in the breeding range from the European Arctic to western Siberia which has been linked to ongoing agricultural intensification in the Netherlands and deteriorating habitat quality at key stopover sites for northern European breeders. Consequently birds are migrating further east through Belarus and numbers have declined substantially in the west (Rakhimberdiev *et al.* 2011; Verkuil *et al.* 2012 in Balmer *et al.* 2013).

Table 19. BLACK-TAILED GODWIT (*Limosa limosa*)

POPULATION ESTIMATES	AT CLASSIFICATION: race *islandica* 915 on passage (2.6% of the Iceland breeding population, 1996/7 to 2000/1); 1,113 wintering (3.2% of the Iceland breeding population, 1996/7 to 2000/1) ((JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **3,724** wintering (Oct)** (Austin *et al.* 2014)
TRENDS	Short-term trend: -28% Medium-term trend: -2% Long-term trend: +827% Sector trends: Substantial long-term increases have occurred on most sectors for which Black-tailed Godwit trends are available. High alerts have been triggered in the short term for North Killingholme Pits and Cherry Cobb Sands (Middle Humber), and medium alerts for Pyewipe (Middle Humber) and Cleethorpes North Promenade to Anthony's Bank (Outer South) (Ross-Smith *et al.* 2013). UK/Region trends: Numbers of Black-tailed Godwit overwintering within the region and in Britain have been increasing in the long-term. Numbers have fluctuated on the Humber SPA, but appear to be increasing as a proportion of the numbers in the region (Cook *et al.* 2013)
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3003** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob5320.htm**
GENERAL ECOLOGY	DIET: Invertebrates, including beetles, annelid and polychaete worms, molluscs, ragworms, crustaceans and some plant material (Birdlife 2014). HABITAT: Feeds on mudflats on the upper reaches of estuaries, muddy inland lakes, and sometimes on farmland and flooded grassland. Joins high tide roosts (Delany *et al.* 2009). BEHAVIOUR: Feeds by touch and sight (BTO 2014). Birds tend to be highly site faithful both within and between winters (Wernham *et al.* 2002). Very gregarious and occurring in flocks at both feeding and roosting sites (Delany *et al.* 2009). SENSITIVITY TO DISTURBANCE: One of the most tolerant species to walkers along footpaths at low tide, though numbers were still significantly lower at sites close to a footpath (Burton *et al.* 2002a)
LOCAL ECOLOGY	Detailed summaries of the status and ecology of Black-tailed Godwit on the Humber estuary have been produced by Catley (2009) and Percival (2011). The 2011/12 WeBS low tide count highlighted the importance of Pyewipe and North Killingholme Haven Pits for this species during winter (Calbrade 2013). Disturbance: In a sensitivity analysis for the Humber, Black-tailed Godwit was defined as high risk largely on the basis of being a red-listed species (Cutts *et al.* 2009).

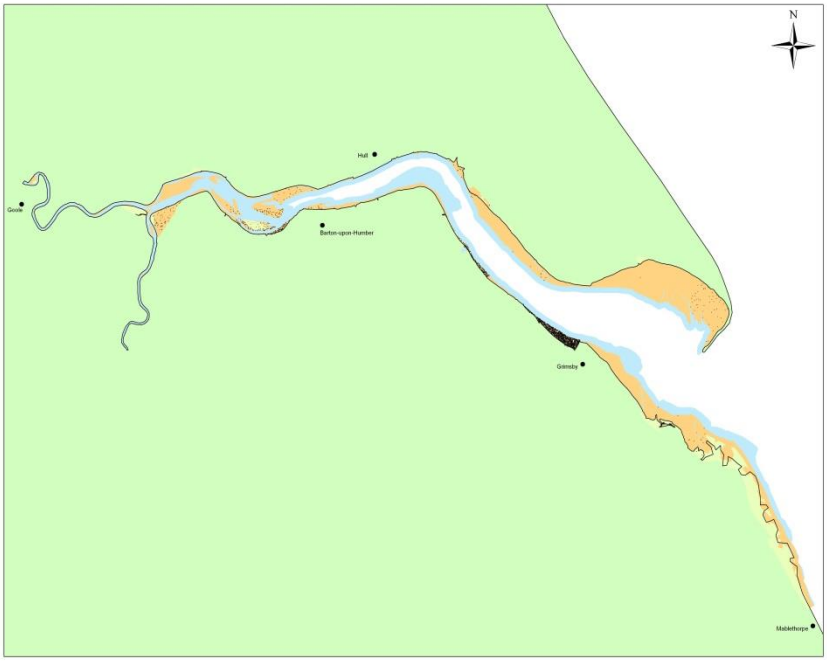
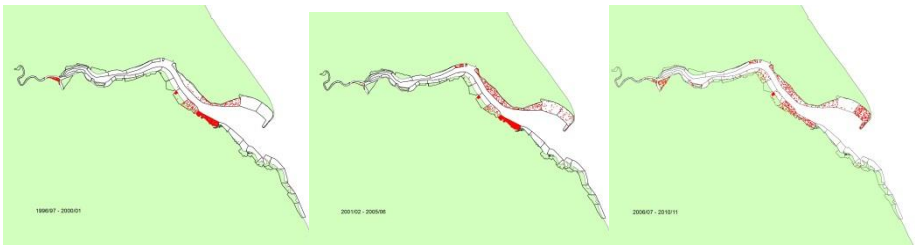
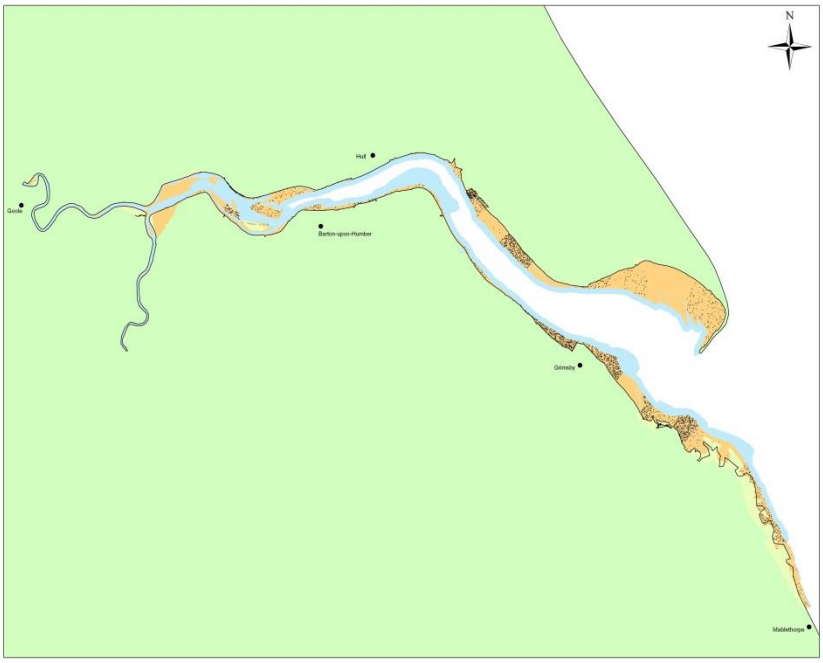
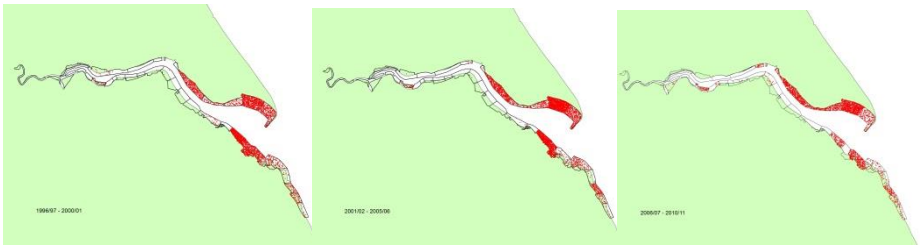
ORIGIN	Two subspecies occur in the UK. *Limosa* breeds in Europe/western Siberia (including very small numbers in the UK), occurring on passage but wintering mainly in Africa. Birds wintering in the UK of subspecies *islandica* which breeds in Iceland (Wernham *et al.* 2002).
REASONS FOR DECLINE	SITE SPECIFIC: The site trend appears to be tracking the increasing regional and British trends, though fluctuations in site counts make interpretation difficult and mean that the alerts that have been triggered should be viewed with caution. The increasing proportion of regional numbers supported by the site suggest that conditions remain relatively favourable for this species and the site is becoming more important regionally (Cook *et al.* 2013)
THREATS	Threats may include pollution and disturbance (Birdlife 2014). Subspecies *islandica* has a relatively restricted distribution and is dependent on a relatively restricted number of sites especially during passage (Wernham *et al.* 2002). The Killingholme development is a major threat (if the development is going ahead) as this is an important site. However, Percival (2011) believed that the proposed new management realignment scheme would provide more than enough to compensate for the development.
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.   Relative distribution within The Humber relatively stable over the three periods.

Table 20. BAR-TAILED GODWIT (*Limosa lapponica*)

POPULATION ESTIMATES (HUMBER)	AT CLASSIFICATION: 2,752 wintering (4.4% of the population in GB, 1996/7 to 2000/1) ((JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **2,950**** (Austin *et al.* 2014)
TRENDS (HUMBER)	Short-term trend: -7% Medium-term trend: -2% Long-term trend: +70% Sector trends: Bar-tailed Godwit numbers have been increasing or stable over all three time periods in the Outer North area, but have declined at Cherry Cobb Sands (Middle Humber). Trends were variable in the Outer South sectors, with increases at Grainthorpe Haven's Pye Hall to Horseshoe Point, Donna Nook, Saltfleetby and Theddlethorpe to Mablethorpe North End, but decreases elsewhere (Ross-Smith *et al.* 2013) UK/Region trends: Numbers of Bar-tailed Godwit wintering in the region and within Britain have remained relatively stable in the long term. The proportion of birds using the Humber SPA has also remained relatively stable (Cook *et al.* 2013).
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3005** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob5340.htm**
GENERAL ECOLOGY	DIET: Polychaete worms are the principal food source during winter. Atkinson *et al.* (2010) give the proportion of worms in the diet as 94%, based on Leopold 2004a,b. Duijns *et al.* (2013) stated 79% Ragworm *Hediste divesicolor* , 17% King ragworm *Alitta virens*. And 2% Lugworm *Arenaria marina*. The sexes are dimorphic and feed in different parts of the estuary. In one study, females feed at the tide's edge and ate 71% lugworms *Arenaria marina*, whereas the smaller subordinate males feed on mudflats and took only 18% *A. marina*. (Duijns & Piersma 2014). HABITAT: During winter mostly feeds on mudflats in estuaries, with birds around the North Sea generally preferring the outer parts of estuaries where substrates are usually sandy (Musgrove *et al.* 2003 & Scheiffarth 2001 in Delany *et al.* 2009). Joins mixed wader roosts at high tide. BEHAVIOUR: Highly gregarious in winter, forming large flocks (Delany *et al.* 2009). Many birds are site faithful, during subsequent winters, but small numbers do move sites both within and between winters (Wernham *et al.* 2002). SENSITIVITY TO DISTURBANCE: Relatively sensitive to disturbance compared to other wader species (e.g. Kirby *et al* 1993 in Cutts *et al* 2009; Davidson & Rothwell 1993 in Mander & Cutts 2009)

LOCAL ECOLOGY	The most important sectors for Bar-tailed Godwit are the three sectors that make up the Outer (North) area, and the adjacent Cherry Cobb Sands (Middle Humber) (Ross-Smith *et al.* 2013), and Paull Holme Strays (also Middle Humber) (Calbrade 2013). A distribution model for Bar-tailed Godwit on the Humber produced six environmental variables as predictors of distribution in estuarine areas, explaining 85% of density data variability. The most important predictor is the intertidal area in the sector, with higher density expected where this is <5 km^2. The intertidal habitat type is also important, in particular where the substratum is dominated by littoral sands (Franco *et al.* 2013).
ORIGIN	British wintering birds come from the population breeding in northern Europe/ western Siberia (*lapponica* race). Some birds may migrate directly to Britain in autumn, but most birds stage in the Wadden Sea in March ahead of their return migration Delany *et al.* 2009). Some birds from more easterly breeding populations may pass through the UK on passage (Wernham *et al.* 2002).
REASONS FOR DECLINE	The site trend does not appear to be tracking either the Regional or British trend, but the fact that no alerts have been triggered and the relatively stable proportion of regional numbers on this site suggest that there are no site-specific issues for this species (Cook *et al.* 2013). OTHER: There is evidence that an easterly shift in the wintering distribution of this species has occurred in Europe in response to climate change (Maclean *et al.* 2008).
THREATS	Degradation of feeding habitat due to land claim, pollution and disturbance (Birdlife 2014).
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.





Relative distribution within The Humber relatively stable over the three periods.

Table 21. CURLEW (*Numenius arquata*)

POPULATION ESTIMATES	AT CLASSIFICATION: **3,253** wintering (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **3,247*** (Austin *et al.* 2014)
TRENDS	Short-term trend: +3% Medium-term trend: +1% Long-term trend: +83% Sector trends: Sector trends for Curlew are extremely variable, with many sectors showing both increases and decreases over the different time frames. Increases over all three timescales occurred at Brough Haven to North Ferriby (Inner Humber), Somercoates to Donna Nook and Theddlethorpe to Mablethorpe North End (both Outer South) and substantial decreases over all three time frames at Barrow to Barton including Barton Pits (Middle Humber) (Ross-Smith *et al.* 2013) UK/Region trends: Numbers of Curlew wintering in the region have remained stable in the medium term after increasing, and numbers in Britain have declined in the medium term after peaking. The proportion of regional numbers using the Humber SPA has remained relatively stable (Cook *et al.* 2013)
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3012** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob5410.htm**
GENERAL ECOLOGY	DIET: Variable, including worms, crustaceans and molluscs (del Hoyo *et al.*, 1996). Atkinson *et al.* (2010) listed proportions during winter as 46% bivalves, 35% worms and 19% other, based on Leopold 2004a,b. HABITAT: Mainly feeding along muddy shorelines of estuaries, lagoons, lakes and rivers, with some birds also using inland fields (Delany *et al.* 2009). Roosts at high tide among communal mixed wader flocks. BEHAVIOUR: Gregarious during winter, occurring in small to large flocks (Delany *et al.* 2009). Birds are thought to mostly be site faithful within and between winters (Wernham *et al.* 2002). Food located primarily by touch (BTO 2014). SENSITIVITY TO DISTURBANCE: High. Numbers were significantly lower at sites close to footpaths and Curlew is very intolerant to the presence of walkers (Burton *et al.* 2002a)
LOCAL ECOLOGY	The most important WeBS sectors during core counts are to the north of the estuary at Cherry Cobb Sands (Middle Humber) and Patrington to Easington (Outer North) (Ross-Smith *et al.* 2013). They were found across the site during the 2011/12 low tide counts, with the highest numbers at Read's Island (Inner Humber), Pyewipe, Salt End (both Middle Humber) and Theddlethorpe St. Helen (Outer South) (Calbrade 2013). Studies by MacDonald (2009) and Beriro & Goodall (2007) confirm that some birds on the Humber do feed inland in Lincolnshire. Individual-based survival models predicted that field feeding may be important to maintain Curlew populations on the Humber (Stillman *et al.* 2005).

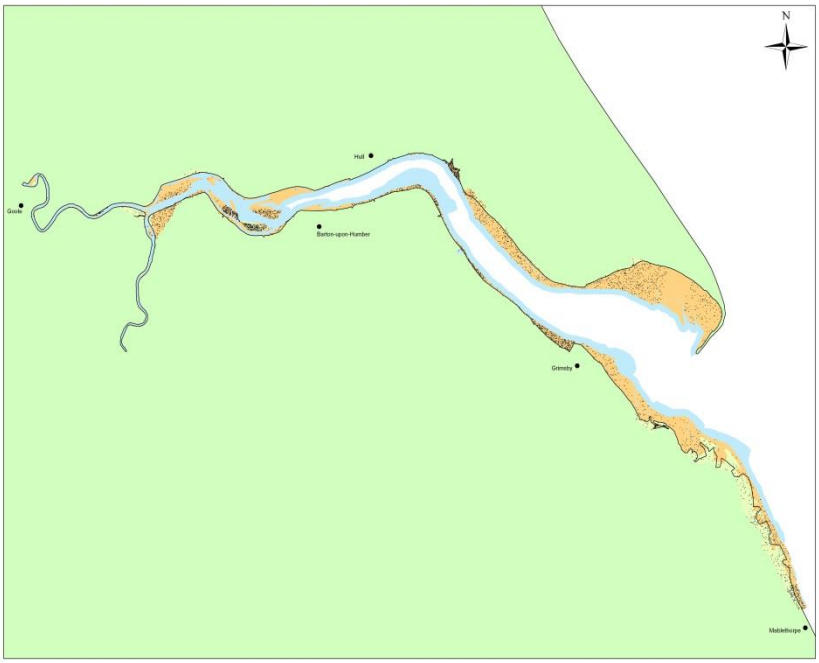
	One sensitivity assessment defined the species as at a 'Moderate' risk to disturbance on the Humber, but with a comment suggesting this was mainly because the species was amber-listed rather than red-listed in the UK, and that the risk level may need to be upgraded to 'High' in the future (Cutts *et al.* 2009).
ORIGIN	British breeding Curlews mostly winter in the south-west and in Ireland, and the vast majority of Curlews on the east coast in winter are from further north and east, mainly from Scandinavia (Wernham *et al.* 2002).
REASONS FOR DECLINE	The stable (or even slightly increasing) proportion of regional numbers on the site suggests that conditions remain relatively stable for this species (Cook *et al.* 2013). There is evidence that this species is shifting its wintering distribution north-eastwards in response to climate change, with the 'weighted centroid' of the wintering distribution in western Europe moving 119km to the northeast between 1981 and 2000, suggesting that a larger proportion of birds are wintering in mainland Europe rather than Britain (Maclean *et al.* 2008).
THREATS	Breeding populations may be threatened by habitat loss, and wintering populations by disturbance, development and pollution (Birdlife 2014).
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.   Relative distribution within The Humber relatively stable over the three periods

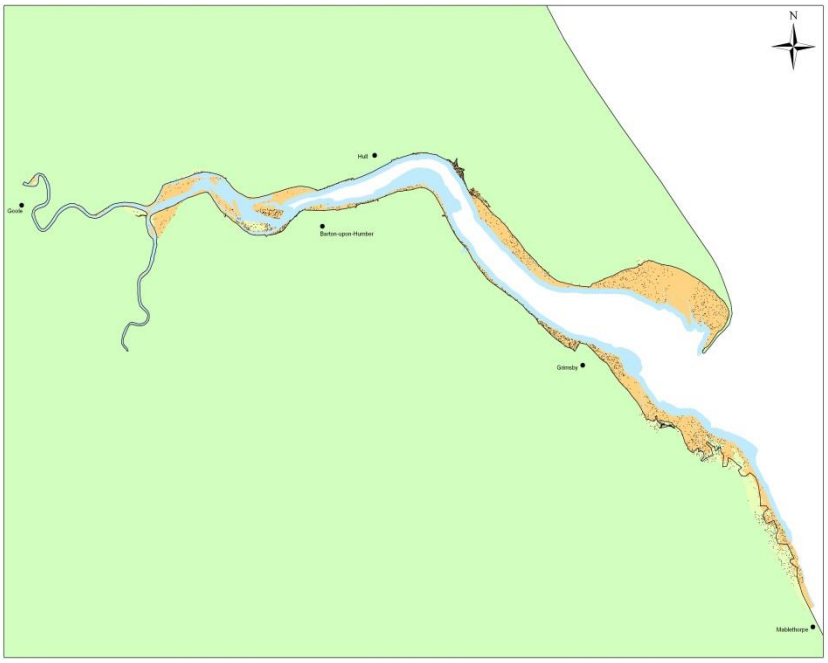
Table 22. GREENSHANK (*Tringa nebularia*)

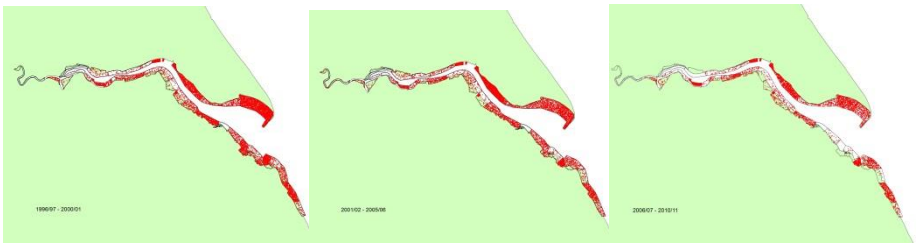
POPULATION ESTIMATES (HUMBER)	AT CLASSIFICATION: **77** on passage (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **68*** on passage (Aug)(Austin *et al.* 2014)
TRENDS	Site trends are not available as this species is not included in WeBS Alerts (as it is not a listed feature of the site). Sector trends are not available as this species was not included in Ross-Smith *et al.* (2013). Regional trend comparison: not considered for WeBS Alerts
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3019** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob5480.htm**
GENERAL ECOLOGY	DIET: Mainly carnivorous, including insects and larvae (especially beetles), crustaceans, annelids and molluscs (del Hoyo *et al*. 1996). HABITAT: A wide variety of freshwater and marine habitats, including estuaries (various in Birdlife 2014) BEHAVIOUR: Mostly solitary or in small groups, though may occur in larger groups on passage or at roost sites. Birds often return to the same localities on passage and in winter (Underhill 1997 in Delany *et al.* 2009; Wernham *et al.* 2002) SENSITIVITY TO DISTURBANCE: Unknown
LOCAL ECOLOGY	Recorded throughout the year, but numbers peak on passage. During 2011/12, double figure counts were recorded at Blacktoft Sands, Alkborough and Spurn in August or September.
ORIGIN	Breeds mainly in Scandinavia, northern Russia and Siberia, with a small population in Scotland (Delany *et al.* 2009). Scottish breeders are thought to winter in western Britain and in Ireland, and birds on the Solent may be from Scandinavia (Wernham *et al.* 2002). Therefore, it seems most likely that birds on the Humber are from Scandinavia or possibly Russia.
REASONS FOR DECLINE	Unknown – no evidence of a decline.
THREATS	Habitat degradation and loss in Asia. No threats mentioned for European populations (Birdlife 2014).

Table 23. REDSHANK (*Tringa totanus*)

POPULATION ESTIMATES	AT CLASSIFICATION: race *totanus* **7,462** on passage (5.7% of the eastern Atlantic wintering population, 1996/7 to 2000/1); **4,632** wintering (3.6% of the eastern Atlantic wintering population, 1996/7 to 2000/1) (JNCC 2014). WeBS 5-year peak mean as of winter 2012/13: **3,459** (Sep)** (Austin *et al.* 2014)
TRENDS	Short-term trend: -31% Medium-term trend: -42% Long-term trend: +3% Sector trends: Sector level trends for Redshank are extremely variable across all parts of the estuary. High alerts over all three timescales have been triggered at Winteringham Haven and South Ferriby (both Inner Humber), North Killingholme Pits (Middle Humber), Cleethorpes North Promenade to Anthony's Bank, Donna Nook (both Outer South) and Spurn Head (Outer North) (Ross-smith *et al.* 2013). UK/Region trends: Numbers of Redshank wintering in the region have declined in the medium term after peaking, whereas wintering numbers in Britain have remained relatively stable long term. The proportion of birds from the region that are using the Humber Estuary SPA has declined since the mid-2000s (Cook *et al.* 2013), indicative of a site specific issue.
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3017** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob5460.htm**
GENERAL ECOLOGY	DIET: Invertebrates, including insects, spiders, annelid worms, molluscs and crustaceans (especially amphipods). Atkinson *et al.* (2010), gives diet proportions after Leopold *et al.* (2004a,b), of 46% worms, 7% bivalves and 47% 'other'. HABITAT: Mainly coastal, including mudflats and tidal estuaries joining mixed wader roosts at high tide (Delany *et al.* 2009). BEHAVIOUR: Some adults are solitary and defend feeding territories in winter, others occur in flocks (Delany *et al.* 2009) UK Redshanks are usually site faithful in winter, though long distance movement sometimes occurs probably in response to cold weather (Wernham *et al.* 2002). SENSITIVITY TO DISTURBANCE: Flight distances of c.100m were noted by Smit & Visser (1993). Susceptible to disturbance from construction and other activities as often feeds closer to shore than other waders (Cutts *et al.* 2009). Redshanks are particularly susceptible to disturbance in severe weather (e.g. Clark *et al.* 1993). As they take small prey in relation to their body size, they need to feed for longer periods during the tidal cycle than other species and therefore have less scope for extending feeding time when necessary to meet their energy requirements (Mitchell *et al.* 2000)

LOCAL ECOLOGY	Redshank were distributed across the site during the 2011/12 low tide counts, and found in any areas with exposed mud (Calbrade 2013). The most important WeBS sectors for this species during the core counts were Cherry Cobb Sands and the sectors in the Outer North area (Ross-Smith *et al.* 2013). A distribution model for Redshank on the Humber produced seven environmental variables as predictors of distribution in estuarine areas, explaining 82% of density data variability. The most important predictor is the extent of intertidal area available, and intertidal habitat type is also important, with higher densities expected where a component of littoral sand is present (alone or mixed with littoral mud or mixed sediments) (Franco *et al.* 2013). At Saltend on the Humber excluded from area within 75-100m of construction activity, with a greater exclusion distance up to c.250m for larger groups (Cutts & Allen 1999), though in some instances will feed closer to activity when feeding in creek systems (Mander & Cutts 2009). Defined as highly sensitive in sensitivity assessment of the Humber due to its vulnerability in cold weather (Cutts *et al* 2009)
ORIGIN	The taxonomy is controversial with different forms recognised by different authors. British birds are only partially migratory and may stay close to their breeding area, especially in the south of the UK (Cramp & Simmons, 1983 in Delany *et al.*, 2009). They are joined in winter by large numbers from Iceland (*Tringa totanus robusta*) and a few birds from the continent (Wernham *et al.* 2002).
REASONS FOR DECLINE	SITE SPECIFIC: The site trend has been decreasing in the medium term having previously peaked. The site trend does not match the regional or British trend, and the declining proportion of numbers supported by this site suggests that site-specific pressures may be affecting this species (Cook *et al.* 2013). OTHER: Widespread declines in Britain and Europe have been attributed to agricultural intensification on the breeding grounds (Delany *et al.* 2009), with the British breeding population declining by 44% over the period 1995-2012 (Harris *et al.* 2014). There is evidence that a north-westerly shift in the wintering distribution of this species has occurred in Europe in response to climate change (Maclean *et al.* 2008). However there is no direct evidence that this has affected numbers on the Humber.
THREATS	Particularly susceptible to cold weather (Wernham *et al.* 2002). Also drainage for agriculture and loss of tidal mudflats (various in Birdlife 2014).
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.

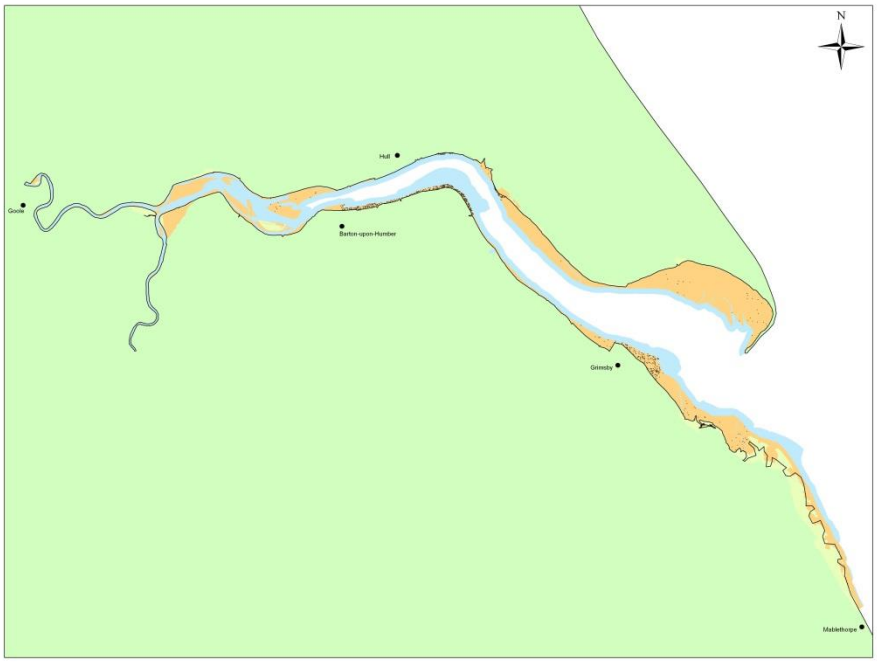




Relative distribution within The Humber relatively stable over the three periods though there has been an apparent decline on the Lincolnshire coast in the most recent period.

Table 24. TURNSTONE (*Arenaria interpres*)

POPULATION ESTIMATES	AT CLASSIFICATION: **629** wintering (JNCC 2014) WeBS 5-year peak mean as of winter 2012/13: **365** (Austin *et al.* 2014)
TRENDS	Site trends are not available as this species is not included in WeBS Alerts (as not a listed species for the site). Likewise, sector trends are not available as this species was not included in Ross-Smith *et al.* (2013). Regional trend comparison: not considered for WeBS Alerts
LINKS	BIRDLIFE: **http://www.birdlife.org/datazone/speciesfactsheet.php?id=3034** BTO BIRDFACTS: **http://blx1.bto.org/birdfacts/results/bob5610.htm**
GENERAL ECOLOGY	DIET: A wide range of invertebrates and other material (BTO 2014). Atkinson *et al.* (2010), giving proportions after Leopold *et al.* (2004a, 2004b), indicate that the diet consists of 20% bivalves, 5% worms and 75% 'other'. HABITAT: Often along rocky or stony shores, but also on mudflats or sandy shores where there are pebbles, shores, washed up seaweed (Delany *et al.* 2009), or beds of molluscs (del Hoyo *et al.* 1996). Usually occurs in small groups, but may form larger flocks at roost sites (Delany *et al.* 2009) BEHAVIOUR: Locates food by sight, sometimes by turning over pebbles or other items which has given the bird its common name in English (BTO 2014). Highly site faithful, both within and between winters, often remaining in flocks with the same membership (Wernham *et al.* 2002). SENSITIVITY TO DISTURBANCE: Not particularly nervous compared to other wader species (Davidson & Rothwell 1993), allowing a closer approach than other species (Cutts *et al* 2009)
LOCAL ECOLOGY	The most important areas for Turnstone within the Humber SPA are on the rocks around New Holland between Barton upon Humber and East Halton (Middle Humber) and between Grimsby and Cleethorpes (Outer South) (Calbrade 2013). These rocky areas are now covered in silt due to accretion but birds have adapted to feed on jetties and around the harbours (G.Catley pers comm). This species was the exception amongst waders studied by Franco *et al.* 2013, and was mainly distributed in areas with hard substrata rather than intertidal habitats (Brough Haven to Hessle Haven and Hessle to Hull). Despite the fact that the species allows a closer approach before taking flight, Cutts *et al* (2009) defined this species as having high sensitivity in a sensitivity assessment for the Humber, because it has specific habitat requirements and a limited range in the Humber.
ORIGIN	The vast majority of Turnstone wintering in the UK are from the Canada/Greenland population, and use Iceland as a stopover during migration; a small number come from Fennoscandia (Wernham *et al.* 2002).

REASONS FOR DECLINE	Declines shown by the non-estuarine winter shorebird count are thought to have been caused by a northerly range shift brought about by climate change (Rehfisch *et al.* 2004). Turnstone is among the species listed by Burton *et al.* (2002b) as potentially at risk from changes to invertebrate food availability caused by sewage treatment.
POTENTIAL THREATS	Not known
DISTRIBUTION WITHIN THE HUMBER	Above: WeBS Low Tide data (from Calbrade 2013). Below: WeBS Core Counts (high tide) for the three periods: 1996/97-2000/01; 2001/02-2005/06; 2006/07-2010/11.  Core Count distribution maps are not included for Turnstone as these were not included in Ross-Smith *et al.* (2013).

3.2 HUMBER ESTUARY SPA: SUMMARY OF RELEVANT LITERATURE

3.2.1. Habitats within Humber Estuary SPA

The Humber Estuary drains a large area of eastern and central England, with the river basin area covering 26,109 km^2 and ranging from the North York Moors to Birmingham (Environment Agency 2009). The majority of water reaches the Humber via the River Ouse and River Trent. The approximate distance from the convergence of the Trent and the Ouse to the outer estuary at Spurn Point/Donna Nook is 62km (Jones *et al.* 2000, TIDE 2014). The whole estuary is tidal with extensive intertidal mudflats occurring especially in the outer estuary, and narrower strips of mudflat elsewhere with vertical sea walls in front of the docks at Hull, Grimsby and Immingham but a boulder strewn area at the top of the mudbank elsewhere (Jones *et al.* 2000). The Humber contains at least 22 of the 34 biotopes identified in the Marine Nature Conservation Review section 6 inlets of eastern England assessment (Jones *et al.* 2000), and is dominated by soft substrata, with the most extensive biotopes being intertidal muddy environments (Jones *et al.* 2000). Other important habitats with the SPA boundary that are of particular relevance to the birds featuring in this review include subtidal habitat, saltmarsh, reedbeds and coastal lagoons (Allen *et al.* 2003).

Outside the SPA boundary, the most significant habitat for the species considered in this review is farmland, with both grasslands and arable fields being used by a number of species as foraging habitat, and fields immediately adjacent to the SPA also being used as roosting sites on the highest spring tides.

3.2.1.1. Intertidal habitat

The intertidal habitats on the Humber are highly representative of North Sea estuaries, and range from gravels and sands to muddy sands and mud, with nearly 50% of the area of the Humber Estuary being exposed at low tide (Black & Veatch 2005). Intertidal mudflats occur along most of the estuary, but flood defences limit their development across much of its length (Allen *et al.* 2003). The width of the mudflats increases towards the Outer estuary and there are extensive mudflats inside Spurn Bight (Outer North area) and at Cherry Cobb (Middle Humber area) (Jones *et al.* 2000; Allen *et al.* 2003; Black & Veatch 2005), with smaller muddy embayments at Saltend/Paull and at Pyewipe (Middle Humber area) (Allen *et al.* 2003). There are also extensive intertidal areas on the south bank at Cleethorpes and Donna Nook (Outer South area) which are sandier in character than those on the northern bank (Jones *et al.* 2000; Allen *et al.* 2003).

Changes to the extent of intertidal habitat 1936-2000

Historical analysis for the period 1936 – 2000 suggests that there has not been a substantial change to the total intertidal area in the estuary since 1936. However, there have been substantial increases in intertidal habitat in the Inner Humber area and corresponding losses in the Middle Humber area during this period. Smaller increases to the extent of the intertidal area were also noted in the Outer Humber (Black & Veatch 2005).

In the Inner Humber area, an increase in the estuary area at high tide between Brough and the Humber Bridge over a fifty year period has mainly resulted from a reduction in the size of Read's Island with erosion also experienced on the south bank between Winteringham and South Ferriby (Black & Veatch 2005).

In the Middle Humber area, the main losses over a fifty year period have occurred downstream of Paull and are largely matched by an increase in subtidal area in this part of the estuary (Black &

Veatch 2005). Analysis of aerial photos suggests that most of the change in the Cherry Cobb Sands sector (Paull to Stone Creek), where c.220 ha of intertidal mudflat was lost, occurred prior to about 1985, between Sand House Farm and the south end of Paull Holme Strays (Black & Veatch 2011), i.e. on Foul Holme Sands. The average level of the remaining intertidal mudflats in this section of the estuary has also significantly reduced since 1936 (Black & Veatch 2005).

Predicted future changes to intertidal area 2000-2050

Models have been produced to predict changes to intertidal habitat on the Humber due to coastal squeeze, resulting from differing levels of sea level rise as a result of climate change. These suggest a loss of 200 ha of habitat between 2000 and 2050 if the rise in mean sea level is 1.8 mm/year, and a 600 ha loss if the rise in mean sea level is 6mm/year (Black & Veatch 2005). Table 25 shows the breakdown across the different areas of the estuary.

Table 25. Estimated changes in intertidal area 2000-2050, along with historical changes 1950-2000. Reproduced from Black & Veatch (2005).

	Humber (excl. rivers)	Outer Humber	Middle Humber	Inner Humber	Rivers Ouse & Trent
1.8mm/year sea level rise	-200	-50	-140	-10	+5
6.0mm/year sea level rise	-600	-180	-360	-60	+10
Historic change 1950-2000	-55	80	-485	350	Not known

It is envisaged that the most substantial habitat loss over the period 2000-2050 will occur to the mudflats in the Middle Humber area, along with some mudflat and saltmarsh losses in the Outer Humber area, and some losses of reedbeds in the Inner Humber (Black & Veatch 2005). Approximately 70% of the habitat loss is expected to affect mudflat and nearly 25% will affect saltmarsh (Black & Veatch 2005).

In the Humber estuary, a number of "Managed Realignment" schemes have taken place and are planned in the future. These schemes are part of the flood defence strategy, compensation associated with Habitat Regulations linked to port development, and or are expected to replace intertidal habitat that will be lost due to coastal squeeze. Managed realignment is described in more detail in Section 3.2.8.

3.2.1.2 Subtidal habitat

The sub-tidal area lies below the low tide mark, but is still shallow and close to shore, and therefore available as a resource to some species, especially diving ducks, e.g. Pochard, Scaup and Goldeneye. The seabed is mostly sandy with some patches of gravel and glacial till, grading into silty clay in the intertidal areas. Invertebrates dominate the benthic community, including polychaete worms, mysid shrimp and gammarid amphipod species (Black & Veatch 2005). The biotopes and species found in the sub-tidal parts of the Humber are all expected for the area, and there is a clear difference between the communities in the Inner/Middle Humber, and the Outer Humber, where the most diverse groups occur – possibly as a result of changes to salinity (Pears *et al.* 2010). The outer estuary samples were divided between communities assigned to biotopes in infra-littoral sand and in variable salinity infralittoral mud. In the Inner/Middle Humber, most samples were associated with more mobile, sandy substrata (Pears *et al.* 2010).

Changes to sub-tidal habitat

References in the published literature to changes to sub-tidal habitat are limited, though losses of intertidal habitat in some areas may have been matched by increases in sub-tidal area. For example in the Middle Humber, losses of intertidal habitat over the period 1950-2000 were largely matched by increases in sub-tidal habitat over the same period (Black & Veatch 2005).

Dredging

Dredging is carried out in the Humber Estuary to remove recently deposited sediment in order to ensure ships can continue to access the ports. Around 3.3 million m^3 of material per annum was removed from the Humber Estuary and the enclosed docks (including Goole Docks, on the River Ouse) by maintenance dredging carried out by Associated British Ports (ABP) between 2004 and 2010, and disposed at licensed sites as close as practically possible to where the dredging took place (ABP 2011). Dredging is also carried out by other operators on the Humber (ABP 2011). The dredging and disposal sites are mapped (ABP 2011). Surveys over the last century suggest that most (if not all) of the dredged material is circulated throughout the estuary system (ABP 2011). ABP (2011) conclude that dredging is small in scale in the context of the estuary, and that any geomorphological changes resulting from dredging would be difficult to detect as the geomorphology is still in a state of change following historic land claim.

3.2.1.3. Saltmarsh

Saltmarsh comprises less than 2% of the estuarine area of the Humber Estuary, which is substantially less than the national average of other estuarine systems (Allen *et al.* 2003; Black & Veatch 2005). This is partly a result of the geomorphology of the Humber but also due to extensive historic land claim (Allen *et al.* 2003). The composition of the Humber's saltmarshes is also unusual compared to other UK estuaries, with over half the marsh dominated by common reed *Phragmites australis* and sea club-rush *Scirpus maritimus* particularly in the Inner Humber area. In contrast, more typical saltmarsh communities – pioneer marsh, and low, mid and upper marsh communities – are scarce, amounting to less than 1% of the total estuarine area (Black & Veatch 2005).

In some places on the Humber, flood defences restrict the development of saltmarsh (Allen *et al.* 2003), and upper marsh communities have been lost through coastal squeeze (Black & Veatch 2005). In other areas, such as at Cherry Cobb (Middle Humber area) and south of Cleethorpes (Outer Humber South), clear zonation of saltmarsh vegetation occurs from pioneer species through to mid and upper marsh communities (Black & Veatch 2005).

The main areas of saltmarsh are in the Outer Humber area, especially around Tetney Haven, Donna Nook, Saltfleet and Theddlethorpe to Saltfleetly (Outer Humber South) (Allen *et al.* 2003). Elsewhere, fringing saltmarsh is generally wider closer to the Outer estuary and is located along the north bank between Paull and Spurn Point (Middle Humber and Outer Humber North areas), along the south bank from Goxhill Marsh to Barton (Middle Humber), and along some parts of the south bank in the Inner Humber area (Allen *et al.* 2003).

Changes to saltmarsh extent

Land claim and drainage, particularly during the 18^{th} and 19^{th} centuries, had a major effect on the extent of saltmarsh in the Humber, and it has been estimated that 678 ha was lost between the years 1826 and 1977 (IECS 1994 in Allen *et al.* 2003).

Allen *et al.* (2003) state that measuring recent changes to saltmarsh extent is difficult as a result of differences in methodology and reporting styles between the 1988 NVC survey (Burd 1989 in Allen *et al.* 2003) and a more recent NVC survey (Bullen Consultants 2001 in Allen *et al.* 2003). Black & Veatch (2005) state a figure of 627 ha of saltmarsh in 1995 based on aerial photographs, whereas the NVC survey mapped 664 ha of saltmarsh (Bullen Consultants 2001 in Elliott & Boyes 2003). Other research suggests a small increase of 37 ha in the Humber as a whole, with losses occurring in the Outer estuary being offset by increases in the Inner estuary (ABP Research 1996 in Allen *et al.* 2003).

Analysis of aerial surveys from 1976 and 1995 was carried out by Black & Veatch (2005) to assess the changes to saltmarsh extent. An increase in saltmarsh of 60 ha in the Inner Humber upstream of Hull was in line with the findings of Allen *et al.* (2003). The aerial photographs suggested that the most substantial losses in the Outer estuary had occurred along the north bank east of Hawkins Point (Outer Humber North), but that gains of 75 ha had occurred on the North Lincolnshire coast around Tetley Haven (Outer Humber South) and that a total loss of 25 ha had occurred in the Outer estuary (Black & Veatch 2005). However, increases in saltmarsh extent in the Outer Humber South area have not been reported by all authors. Research by Dargie (2001 in Allen *et al.* 2003) contradicted other studies which suggested accretion has been occurring in saltmarsh vegetation on the site. Dargie (2001) found that a loss of approximately 45 ha of pioneer saltmarsh had occurred on the North Lincolnshire coast since *c*. 1984, with little change to the extent of middle and upper saltmarsh.

More recent evidence suggests that saltmarsh extent is increasing along the intertidal frontage between Humberston Fitties and Cleethorpes, where concern has been expressed, especially in relation to the beach in front of Cleethorpes leisure centre which is used or recreation. Baseline studies were undertaken in 2007 to map the saltmarsh boundary and the main vegetative assemblages within the saltmarsh. Comparison with previous studies suggested that saltmarsh had advanced towards the low shore as well as along the shore between 2000 and 2005, and that this has continued into 2007 (Allen *et al.* 2008). Black & Veatch (2005) commented that there was no reason to expect that the current expansion of saltmarsh in the upper intertidal zone between Donna Nook and Mablethorpe would cease if sea levels start to rise at 6mm/year, but that the middle and lower intertidal features had been affected by coastal squeeze in the recent past and that this was expected to continue. Since 2003, a number of "Managed realignment" schemes have taken place and have created new intertidal habitat, including saltmarsh. These schemes are described in more detail in section 3.2.8.

Eelgrass surveys

Eelgrass beds are an important feature found in the vicinity of saltmarsh, tending to occur closer to the lower shore where pioneer saltmarsh plants occur. Eelgrass is a preferred food for Brent Goose and is also a resource for other herbivores including Wigeon.

Dwarf Eelgrass (*Zostera noltei*) was noted as growing extensively at Spurn Bight in 1976 and 1985, and also grew on the North Lincolnshire Coast and along the coastline between Pyewipe and Cleethorpes in the 1980s (Allen *et al.* 2003). During the 1990s, unidentified eelgrass species were reported intermittently at Spurn, but a search in 2002 failed to record any (M. Coverdale, pers. comm. in Allen *et al.* 2003) and Smith (1996 in Allen *et al.* 2003) reported that there were no large populations of dwarf eelgrass within Lincolnshire.

More recent surveys of eelgrass took place at Horseshoe Point in 2013 (Stoutt 2013) and at Spurn in 2013 and 2014 (YWT 2013; YWT 2014). At Horseshoe Point, in North Lincolnshire, the survey found only a single small patch of eelgrass. Although other small patches may have been present, it was thought unlikely that any significant beds of eelgrass were present (Stoutt 2013). The Spurn survey

in 2013 mapped some patchy areas of eelgrass and found a larger and denser bed between posts 44 and 50. In 2014, some 10,000 square metres of *Zostera* bed was recorded in total compared to 2,100 square metres in 2013. The presence/absence within $10m^2$ grid squares was also compared with 2013. Eelgrass was present in 6% of squares in 2013 and 8.3% of squares in 2014. However, it was only present in 2.4% in both years so was lost from 3.5% of squares and gained in 5.8% of squares (YWT 2014).

Zostera spp. are highly intolerant of smothering by epiphytes or algal mats and may also be affected by increased turbidity, sea level rise, grazing by wildfowl and invasive species such as *Spartina anglica* (Hardy & Wong 2006). It is thought that bait digging may also damage the eelgrass beds. Although bait digging is banned within the survey area as a result of a byelaw, evidence of bait digging was seen during the survey (YWT 2014). The 2013 report noted that all the *Zostera* recorded was relatively high on the shore and that bait digging takes place on the lower shore and advised that further surveying should be undertaken as well as comparison with visitor usage data to ascertain if trampling might be posing a threat to eelgrass (YWT 2013).

Changes to intertidal and saltmarsh habitat, 1985-2010

In order to assess if changes to the extent of intertidal habitat have contributed to some of the recent changes to bird populations on the Humber, the key period of interest is from 1984/85 to 2009/10, which covers the reference period for the most recent long term WeBS Alerts. However, the literature review did not find any detailed information to quantify changes over this period at a WeBS sector level and enable detailed comparisons to be made with changes to bird populations.

At least some of the erosion noted at Read's Island occurred since the early 1980s, with the reach between Crabley and Brough accreting over the same time period and Whitton Sand accreting to such an extent that it has become vegetated (Allen *et al.* 2003), and has now reached close to the high water level (Black & Veatch 2005). The predictions for 2000-2050 suggest that the extent of mudflat within the Middle Humber is continuing to decrease, suggesting that recent losses may have occurred in this area. The trend for both the Inner Humber and the Outer Humber are less clear, as historical gains are expected to turn to losses during the first half of the current century, and it is unclear from the report when this changeover will occur. More detailed information for this period is recorded for some areas.

Cutts *et al.* (2012) carried out an assessment of WeBS data and habitat change for a number of sectors within the Upper Humber Wildfowl Refuge, in the Inner Humber area, which includes four WeBS sectors (Faxfleet to Weighton Lock; Weighton Lock to Crabley; Crabley to Brough; and Whitton Island and Sands). Changes to habitat over time were assessed using aerial photographs from 1961, 1988, 2003 and 2008, as well as LIDAR and admiralty chart data. They noted that Whitton Island changed from mudflat to vegetative cover between 1988 and 2003. Changes from mudflat into saltmarsh and reedbed along the majority of the north bank of the Inner Humber also seems to have occurred in the late 1980s, although this finding was based on limited data points, and aerial photographs show that a very rapid change from mudflat to saltmarsh occurred in the Brough to Crabley section, between 1999 and 2003 (Cutts *et al.* 2012).

Analysis of abundance data for the Inner Humber area showed variable results, but a decrease in numbers for most wader species appeared to occur from a peak in the late 1980s and early 1990s, and the decline appears to have accelerated in the 2000s (Cutts *et al.* 2012). Data from the Humber Wildfowl Refuge area wardens' reports indicate that Dunlin numbers declined from the early 1990s, and that Curlew numbers have increased from the 1990s (Cutts *et al.* 2012).

The patterns are more variable at sub-sector level, though usage of the north bank has decreased over the last couple of decades, with Shelduck, Redshank and Dunlin showing declines, in particular in the Brough to Crabley sector (Cutts *et al.* 2012). Statistical analysis suggests that these declines may be linked to the habitat changes, though it was noted that Dunlin has undergone population declines at a national scale since a peak in the 1990s, and the link between Redshank and habitat usage was complicated, with a the declining trend apparently linked to the decline in mudflat availability, but a positive relationship with saltmarsh also being found, perhaps reflecting an edge effect and creek feeding preferences or another factor (Cutts *et al.* 2012). In contrast to the previous three species, an increasing abundance trend on the north bank for Mallard based on WeBS data was related to the increasing extent of saltmarsh and reedbed coverage, and occurred in spite of a wider decline for this species on the Humber as a whole (Cutts *et al.* 2012).

Analysis was also carried out for Wigeon. Numbers underwent an increase in the area during the 1970s, perhaps reaching carrying capacity at the time, but has since decreased even though habitat provision has remained stable, perhaps indicating that suitable habitat exists elsewhere in the estuary (e.g. at Whitton Sand), and/or that some degradation of the traditional site has occurred and/or competition is occurring with other species, e.g. geese (Cutts *et al.* 2012).

3.2.1.4. Lagoons/freshwater pits

Coastal lagoons provide feeding resources for some species, and often also provide roosting sites for some species at high tide. Within the estuary, coastal lagoons are located at Blacktoft Sands, Read's Island and Welton Waters (Inner Humber area), Barton-upon-Humber, North Killingholme Haven Pits and Pyewipe (Middle Humber), Easington (Outer Humber North), and Northcoates and Humberston Fitties (Outer Humber South) (Black & Veatch 2005).

Changes to lagoons in SPA

There is some concern over the effect of ongoing coastal erosion on the lagoons at Easington, with the habitats possibly at threat from breaching and infilling with sand (Black & Veatch 2008). Large numbers of waders use the lagoons for roosting, particularly during high spring tides, especially Knot (up to 63% of the Humber population), Redshank (33%), Dunlin (32%) and Grey Plover (29%), as well as Bar-tailed Godwit (7%), Curlew (4%), Sanderling (3%), Ringed Plover (3%) and migratory Dark-bellied Brent Geese (5%) (Black & Veatch 2008). Of the wader species, the Knot is the species thought to be most at risk from potential deterioration or loss of the lagoons, as the adjacent fields may provide an alternative roost site for other species, but possibly not for Knot which Black & Veatch (2008) suggest may vacate the estuary if other roost sites are not available. However, anecdotal evidence from The Wash indicates that Knot will use fields for roosting (N. Clark, pers. comm.). The lagoons at Easington are also important for breeding Little Terns (Black & Veatch 2008) and as such represent an SPA feature.

3.2.1.5. Other habitats within the SPA boundary

Reedbeds/open water

Reedbeds are an important feature of the Humber, particularly in the Inner Humber at Blacktoft Sands and Goole (Allen *et al.* 2003; Black & Veatch 2005), and also at Faxfleet-Broomfleet Island, Whitton Sand and the Barton and Barrow Clay Pits (Allen *et al.* 2003). The sites with reedbeds provide foraging and roosting sites for wildfowl, in particular where open water is present, especially at Blacktoft Sands and Barton and Barrow Pits. They also support important SPA species such as Bittern and Marsh Harrier, but neither species are considered in this report.

The extent of reedbed within the Humber estuary appears to have increased, with 207 ha recorded in 1993 (Selman *et al.* 1999 in Allen *et al.* 2003) and c.380 ha stated in Allen *et al.* (2003), based on the 2001 NVC surveys. However, Allen *et al.* (2003) also warn that it is not clear how the boundaries of the two surveys correspond, and do not provide information about where the most important increases in coverage have occurred. Some losses are predicted for the period 2000-2050 caused by rising sea levels and coastal squeeze as a result of climate change (Black & Veatch 2005).

Sandy beaches

Sandy beaches are a particular important part of the outer estuary in Lincolnshire. Such foreshores can be important area for species such as Sanderling, but often suffer from anthropogenic disturbance associated with sandy beaches (Black & Veatch 2005).

3.2.2. Habitats outside the SPA boundary

Outside Humber Estuary SPA boundary, the adjacent habitat is predominantly comprised of agricultural land, urban settlements and industrial areas. The farmland provides feeding and roosting habitat for birds from the SPA.

3.2.2.1. Farmland as feeding habitat

Inland fields provide foraging opportunities for a number of species considered in this report. Wigeon and Brent Geese both feed on plants and will graze inland. Brent Geese normally prefer grazing in the intertidal area on eelgrass and saltmarsh plants, but over the last twenty years have increasingly used coastal grassland and winter cereal crops once they have depleted their preferred food resources (Kear 2005a).

Although Brent Geese and Wigeon both tend to remain close to the estuary, Pink-footed Geese mainly use the estuary as a roost site, and feed much further inland. Foraging sites are normally located within 10 km of the roost site, and at an optimum distance of 2-5 km (Vickery & Gill 1999 in Birdlife 2014). The species often shows a preference for the same fields from year to year, where it feeds on improved grasslands, cereal stubbles and vegetables (e.g. potatoes, sugar beet, carrots) (Kear 2005a).

As well as herbivores, farmland also supports species such as Lapwing and Golden Plover which feed on invertebrates found within inland grassland and arable fields. Both species often forage for invertebrates in grassland and arable fields both in winter (e.g. Gillings *et al.* 2007). Fields adjacent to estuaries also provide important supplementary feeding habitat for Curlew over winter (Townshend 1981; Stillman *et al.* 2005). Several other species of wader will also feed in fields occasionally, including Oystercatcher, Black-tailed Godwit and Redshank (Stillman *et al.* 2005).

Farmland as feeding habitat

One of the main issues in the Inner (and some parts of the outer north) part of the Humber is a lack of hinterland habitat for wildfowl and also some waders. The land is very intensively farmed with very few, if any, stubbles left overwinter and during harvesting, with modern machinery, there has been a reduction in spill of seed; old combine harvesters used to drop 3% of their yield, now they only drop 0.9% (Short pers comm). Farming within SPA is not being carried out in a wildlife friendly way, still lots of chemicals being used and no field margins being left.

Studies of Golden Plover, Lapwing and Curlew in North Lincolnshire

Although suitable farmland habitat is located around much of the estuary, the only detailed surveys of habitat use are from the south bank of the Humber in North Lincolnshire, which is already an industrial area and where further industrialisation is planned. A number of studies have been carried

out to assess and map habitat used by Golden Plover, Lapwing and Curlew in this area, both as part of environmental assessments, and also to inform local planning authorities in terms of regional planning purposes.

The two most detailed studies were a desk-based study by Bériro & Goddall (2007) which mapped previous records of the three species, and a detailed literature review carried out by MacDonald (2009). Bériro & Goodall identify the following key roosting and feeding areas in the North Lincolnshire area:

GOLDEN PLOVER: Three populations appear to exist with little interchange between them, at least during the day. (1) Centred on Goxhill Marsh, extending upriver to Barrow Haven and downriver to Halton Marshes, mainly roosting during the day on saltmarsh and grassland, with night time feeding areas not known; (2) centred on the Pyewipe flats where daytime roosting and night time feeding occurs, with some birds roosting by day more than 2-3km inland and night-time feeding areas unknown; (3) the flats south of Cleethorpes down to Grainthorpe Haven, with daytime roosting birds also using fields in the Humberston-Tetney area and presumably feeding in the same areas at night.

LAPWING: Wintering flocks are much more mobile and sizeable flocks are recorded inland where the species uses most farm holdings. There are large concentrations on the flats south of Cleethorpes, at Pyewipe and along the marshes north of Immingham. The amount of interchange between inland and coastal populations is not known.

CURLEW: Appears to use inland areas only for feeding, and at relatively low densities. Some fields seem to be preferred and are used year after year, possibly related to lack of disturbance, to high density of earthworms, or both. Moves to the shore to roost at night, and is regularly seen crossing the river to roost on the north bank.

MacDonald (2009) carried out a comprehensive literature review of the requirements of the three species, as well as Ruff and Whimbrel, and found that habitats with relatively short sward heights were preferred, mostly within 1km of the estuary. Arable and grassland habitats are favoured, particularly by Golden Plover, Lapwing and Ruff, and Curlew had broader habitat requirements. Lapwing and Golden Plover preferred larger fields, whereas Ruff used smaller fields and Curlew a range of large and small fields. A more detailed summary of habitat requirements for each species is provided in MacDonald (2009). MacDonald (2009) identified the key areas of importance as the areas to the north of North Killingholme Pits, to the south of Immingham, and immediately inland of the northern end of East Halton Skitter. However, the report also noted that nocturnal feeding habitat was currently unknown and hence some of the fields that do not appear to be used during the day may become important at night. It is therefore important that any decisions regarding mitigation should take account of the uncertainties about the nocturnal usage of fields in the area.

Inland wind Farms

Although most birds remain close to the estuary, some birds use fields further inland, and may therefore be at risk from inland wind farms. Small numbers of Golden Plover and Lapwing were recorded during surveys carried out as part of the environmental statement for a proposed wind farm at Saxby Wold, 3.5 km south-west of Barton-upon-Humber, with some observed feeding at night during nocturnal surveys (RWEnpower 2008). High numbers of Pink-footed Geese were also observed in this study area, with a peak of 1,000+ in each winter (2006/7 – 2008/9). This site appears to be used predominantly as an autumn staging area by Pink-footed Geese rather than being used through the whole winter. Overall, the assessment concluded that wind farm development would have a likely significant effect on nearby statutory sites, including the Humber

SPA, but after an Appropriate Assessment and agreement on mitigation, including provision of alternative habitat within an associated goose management scheme, the proposal was judged to not have an adverse effect on integrity (RWE npower 2008).

3.2.3. Roost sites

Locations of wader and wildfowl roosts around the Humber are shown below.

Fig. 3 Overview map of some of the key locations (by WeBS sector) for roosting waders on Humber Estuary SPA (IECS unpubl. data; full dataset was not available for inclusion in this report).

3.2.4. Habitat quality

The condition of the intertidal and sub-tidal mudflats on the Humber has been monitored through regular sampling programmes by the Environment Agency in order to assess the invertebrate communities. Key (1983, in Jones *et al.* 2000) listed a total of 180 invertebrate species recorded at Spurn Bight, and hence confirmed that the estuary was inhabited by all the species expected to be present in this part of Europe (Jones *et al.* 2000). More recent surveys have also confirmed that the benthic invertebrate communities are typical, and the most recent assessment of the condition of the SAC, based on 2008-2010 benthic surveys, classified the estuary as being in moderate condition in all categories (SAC monitoring data).

Intertidal Habitats – invertebrates

In 2000, the invertebrate composition for three different sections of the estuary was described by HESMP (2005) as follows:

Inner Humber	*Tubificoides pseudogaster* and *Hediste diversicolor*, with a low abundance of other species
Middle Humber (Saltend)	*Hediste diversicolor*, *Abra tenuis*, *Tubificoides benedii* and *Macoma balthica*
Outer Humber (Spurn)	*Phygospio elegans*, *Tubificoides benedii*, *Macoma balthica*, *Retusa obtuse*, *Thorycx spp*. and *Nephtys hombergii*

Elliott & Boyes (2003) found that the distribution of invertebrate communities in the Humber was typical of a large estuary, and this was also confirmed by Allen (2007), who analysed several data sets provided by the Environment Agency from 1999 to 2004 and stated that variations of numbers and species abundance were likely to be the result of natural fluctuations in environmental conditions (e.g. freshwater flow, storms, and changes in sediment characteristics). Higher abundances occurred in the middle estuary on both shores, and sites with lower numbers of species and abundance were generally those in the Inner estuary which are subject to low and fluctuating salinity (Allen 2007).

Allen (2007) also stated that the second stage [not available for review in this report] will be to monitor spatial and temporal trends in benthic communities.

Fujii (2007) carried out a study of the relationships between environmental variables and patterns in the distribution, abundance and biomass of estuarine intertidal macrobenthos. This study was carried out in 2003 and 2004 in order to provide a basis for describing the effect of future sea level rise in the Humber Estuary. The dominant species were found to be two bivalves *Cerastoderma edule* and *Macoma balthicaI,* and a polychaete *Nereis diversicolor*, which made up 51.7%, 25.0% and 12.1%, respectively, of the total biomass. Univariate analyses identified clear trends in species richness, abundance and biomass along the longitudinal and beach width gradient. Multiple regression analysis found that the variances in biomass of *M. balthica*, *C. edule* and other species, and total macrobenthic biomass were largely explained (54-98%) by the key environmental variables, e.g. salinity, organic matter content, beach width and beach slope. Overall, a significant positive relation was found between intertidal habitats with higher macrobenthic biomass and higher salinity, muddier sediments, wider beach and shallower beach slope. Extensive, shallow muddy areas are mostly found in the Outer Humber, and Fujii (2007) suggests that these areas will be most susceptible to the impacts of sea level rise.

Subtidal habitats – invertebrates

The most recent surveys of the sub-littoral benthic invertebrate community identified clear differences between the Outer estuary (from Grimsby to Spurn Head) and the Inner/Middle Humber communities. These are likely to be related to changes in salinity, with the groups with the richest biota being confined to the Outer Humber (Pears *et al.* 2010); similar to the pattern of differences for intertidal communities. The biotopes and species recorded were as expected for the area and none were of conservation importance beyond that generalised for all estuaries (Pears *et al.* 2010). The outer estuary samples were divided between communities assigned to the biotope SS.SSa.IFiSa.NcirBat (*Nephtys cirrosa* and *Bathyporeia spp.* in infralittoral sand), and those assigned to SS.SMu.SMuVS.AphTubi (*Aphelochaeta marioni* and *Tubificoides spp*. in variable salinity infra-littoral mud), found in more muddy sediment. In the Inner/Middle Humber, most samples were

associated with more mobile, sandy substrata, and were mostly assigned to SS.SSa.SSaVS.NintGam (*Neomysis integer* and *Gammarus spp*. in fluctuating low salinity infralittoral mobile sand) (Pears *et al.* 2010).

Pears *et al.* (2010) state that the communities do not fit exactly with those noted by Irving in 1995, but that all the biotopes were predicted by Hemingway in 2008, and that it was likely that further predicted biotopes would occur in other areas that were not sampled. Maps in Pears *et al.* (2010) show the dominant taxa in the different areas. The analyses identified that a number of samples had been identified as 'Extremely disturbed' in the Inner and Middle Humber, but the authors advised that this should be treated with caution as the AMBI system used in the classification system is less robust in low salinity conditions when only a small number of qualifying taxa are recorded (Pears *et al.* 2010).

The effects of pollution and nutrient enrichment

Impacts of sewage enrichment

The water quality in the Humber is mostly dependent on the quality of water coming from its catchment area via the Ouse and the Trent rivers (Elliott & Boyes 2003). Historically, the most serious environmental issue in the Humber has been the dissolved oxygen at the Trent Falls, especially at times of low freshwater flow (Elliott & Boyes 2003). The water quality in the rivers has improved gradually since the early 1960s, and virtually all the main quality targets had been achieved by the mid-1990s (Elliott & Boyes 2003). Improvements in the quality of water from the Trent occurred prior to 1993, and the closure of some industries especially along the Outer South bank was believed to have reduced polluting loads at this time (Jones *et al.* 2000; Allen *et al.* 2003). Further improvements to water quality in the Humber were expected during the 2000s as a result of further planned investments (Jones *et al.* 2000; Elliott & Boyes 2003), e.g. a capital project to treat Hull's sewage by 2001 (Jones *et al.* 2000).

In some cases, sewage outfalls have been shown to contribute towards increases in bird abundance on estuaries and coastal waters, and therefore improvements to sewage treatment are a potential contributory factor towards recent declines in some of the species considered in this report. This occurs because the extra nutrient loading and organic content in sediments resulting from discharges increases the abundance, diversity and biomass of invertebrates. Some species of invertebrates are able to tolerate high levels of organic and nutrient loading close to the source of the discharge, while others benefit from more moderate enrichment occurring over a wider area, including *Corophium*, *Eteone longa*, *Macoma balthica*, *Scolelepsis fuliginosa* and *Mytilus edulis* (Burton *et al.* 2002b). Bird species which feed on benthic invertebrates may therefore be at risk from reductions in food abundance following improvements to water quality. These include species such as Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Oystercatcher, Grey Plover, Lapwing, Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank and Turnstone (Burton *et al.* 2002b). Additionally, some bird species feed directly on waste matter from the discharge. In Scotland, reductions in food discharged from waste water outfalls have been associated with declines in duck species such as Scaup, Goldeneye and Pochard (Campbell 1984; Fox & Salmon 1988; Burton 2002b).

On the Humber, the South Bank Invertebrate report (EA 2002) found that invertebrate species numbers had been higher since 1993, compared to the 1980s, consistent with improved water quality. However, overall abundance was lower for most years since the early 1980s, and the report tentatively suggested that widespread (rather than localised) increases in invertebrate densities had occurred due to organic enrichment from sewage discharges. In the early 1980s both the Grimsby

and Cleethorpes outfalls discharged to the intertidal habitat, and investigations at that time suggested that organic matter from these sources was primarily dispersed along the southern shore of the Humber (EA 2002).

As well as inputs from the Ouse and the Trent, 18 discharge consents existed in the 1980s and 1990s, allowing companies to discharge directly into the Humber, mostly discharging into the Middle Humber area. There was a greater input of BOD (Biochemical Oxygen Demand) from the north bank and of nutrients from the south bank due to the nature of the industries (Elliott & Boyes 2003). Allen (2007) mapped the location of discharges into the Humber and flow rates, with the major discharges including Ciba Geigy, Courtaulds and Tioxide on the south bank between Immingham and Grimsby (Middle Humber, Immingham Docks and Pyewipe WeBS sectors). The species found here were similar to elsewhere but there were moderate to high numbers of *Tubificiodes oligochaetes*. Allen (2007) states that a study by Barnett *et al.* (1996) did find that there had been a reduction in *Tubificiodes benedii* which may have indicated that a reduction in the impact of sewage discharges had taken place.

Pollution from trace metals

Cave *et al.* (2005) found that sediment quality in the Humber is currently far from its 'background state' with respect to trace metals such as arsenic, copper, lead and zinc. This is as a result of the industrial era, with pollution reaching its peak from 1950 to 1970. Levels of trace metals entering the estuary have declined since the 1970s, but the legacy acts to maintain water quality below desired standards (Cave *et al.* 2005). In the tidal rivers, most sites are dominated by pollution tolerant taxa such as *Oligochaeta* spp. (EA 1998, in Cave *et al* 2005). García-Alonso *et al.* (2011) found responses to toxicity in ragworms *Hediste diversicolor* in some areas, which they related to metals such as copper. However, higher level biological responses could not be predicted, and García-Alonso *et al.* (2011) therefore concluded that homeostatis is operating within the estuary.

3.2.5. The effects of construction and development

Construction and development work can affect the intertidal habitat by:

- Causing direct loss of intertidal habitat
- Causing changes to habitat by affecting the geomorphology of the local area or wider estuary.
- Changing/creating habitat intentionally, e.g. through managed realignment schemes (discussed in section 3.2.8 of this report).
- Causing disturbance to birds and other wildlife both during and after construction (discussed in section 3.2.5 of this report).

The most significant major development work to have taken place in the Humber in the recent era is the construction of the Humber International Terminal (HIT), and work at Saltend on the Hull Waste water Treatment outfall and the nearby Queen Elizabeth Docks. Another significant development, of a Marine Energy Park, has also been proposed at Killingholme.

Humber International Terminal

The Humber International Terminal is located at Immingham (Middle Humber, Immingham Docks WeBS sector). The benthic invertebrate community was surveyed before, during and after development, between 1996 and 2005, with some sampling sites located adjacent to the work, and others classed as remote (Adams 2006). Trends for some of the more important benthic invertebrate species are presented in Adams (2006). In summary, large annual fluctuations in

abundance were recorded, but the overall species assemblage of intertidal sites did not change markedly. In 2005, overall abundance of intertidal species was comparable at both the remote and adjacent sites, but lower than in previous years although within the range of natural variation. However, there was a clear post-construction drop in abundance for 'remote' sub-tidal sites, where numbers in 2005 were typically much lower than the 1999 survey but had remained constant since 2001. At adjacent sites, numbers remained relatively constant, and lower than the remote sites throughout the survey period. The feasibility of another development within the same WeBS sector, close to the Humber International Terminal, is also being investigated (Burdon *et al.* 2010).

Saltend

At Saltend (Middle Humber, Saltend Jetties to Paull WeBS sectors), work has taken place at the Hull Wastewater treatment works outfall, and at Queen Elizabeth Docks where a bund was constructed as part of the extension scheme. Monitoring of the topography, benthic invertebrates and birds was carried out in relation to the outfall (Allen & Mazik 2005; Cascade Consulting 2008) and monitoring of disturbance to birds was carried out during the works on the docks (Cutts 2006). The benthic communities were typical of a mid-estuary intertidal community, and results were generally in agreement with previous surveys of the area. Some small changes occurred during the course of the study from 1998 to 2004, but species richness, abundance, diversity and health did not drop below baseline levels (Allen & Mazik 2005). A substantial increase in accretion and mudflat elevation was noted, which was thought to have been caused by the bund structure constructed at the dock (Allen & Mazik 2005; Cascade Consulting 2008).

There have also been a number of changes associated with the existing docks. Cutts (2006) monitored the effects on the bird numbers of activities associated with the Queen Elizabeth Docks extension scheme by ABP; in particular the species and populations associated with the Humber European Marine Site. Saltend remains especially important for GP and to a lesser extent Lapwing, but importance for Black-tailed Godwit has reduced.

The Marine Energy Park

The proposal to develop an energy park at Killingholme (Middle Humber, North Killingholme Marshes WeBS sector) includes a quay and deep water port facilities to support the offshore renewable industry. The Killingholme area is particularly important for Black-tailed Godwit, which roosts at North Killingholme Pits, and feeds on the nearby mudflats (Percival 2011).

Although disturbance would be expected to occur during construction, Black-tailed Godwit would potentially still be able to use the remaining mudflats after development, as the species already uses mudflats adjacent to heavily industrialised areas such as at Pyewipe (Percival 2011). However, this proposal will lead to direct loss of intertidal mudflats, which would have a significant effect on Black-tailed Godwit and therefore require provision of an alternative feeding area in compensation (Percival 2011). A proposed replacement site has been identified at Cherry Cobb Sands on the opposite side of the Humber (Coates 2011; Black & Veatch 2011). The proposed new managed realignment area should deliver sufficient feeding resource so there would be no net loss in the feeding potential of the Humber estuary (Percival 2011). However, the length of time needed for some managed realignment sites to reach their full potential still requires further study, and hence careful associated planning.

3.2.6. Wader diet

Sea level rise may affect foraging potential and related food availability on estuaries. Stillman *et al.* (2005) collected benthic invertebrate data for the Humber as part of a study to produce individual based survival models to assess the quality of the Humber for nine overwintering shorebird species. They used three representative patches in order to collect abundance data in September 1999 and October 2000, and calculated biomass density for five food types: annelids, *Cerastoderma edule*, *Macoma balthica*, *Hydrobia spp.* and *Corophium spp*. The most abundant prey species in each part of the estuary were: Inner Humber – *Hediste diversicolor*; Middle Humber – *H. diversicolor*, *M. balthica* and *Corophium spp*; Outer Humber – *C. edule* and *M. balthica*. Stillman *et al.* (2005) used these data, alongside other data such as the length of exposure of the intertidal mudflats, shorebird populations and species energy requirements, to assess the predicted survival of individuals over winter. From this, they predicted survival rates for species based on food availability. They suggested that this could be used to assess the site quality, and also predict how future changes to the estuary may affect the site quality.

Shorebird survival was most strongly influenced by the biomass density of annelid worms, and the bivalve molluscs *C. edule* and *M. balthica*, and a 2-8% reduction in intertidal area (the expected range of habitat loss stated in the study) led to decreased predicted survival rates for Grey Plover, Black-tailed Godwit, Bar-tailed Godwit, Curlew and Redshank, but not for Oystercatcher, Ringed Plover, Knot or Dunlin. The model predicted that the presence of fields around the estuary provided supplementary feeding areas which increased the survival of Curlews.

Table 26 shows preferred food items of a selection of waders – based on data collected on The Wash in eastern England.

Table 26. Prey preferences of wading birds across the intertidal invertebrate assemblage recorded during The Wash benthic coring surveys. Food items which showed a significant temporal change are highlighted in bold text. Dark-Bellied Brent Goose, Mallard, Pintail and Lapwing are excluded from the table on the grounds that benthic invertebrates do not constitute a substantial proportion of their diets.

Invertebrate family or species	**Bar-Tailed Godwit**	**Black-Tailed Godwit**	**Dunlin**	**Grey Plover**	**Knot**	**Oystercatcher**	**Redshank**	**Sanderling**	**Shelduck**	**Curlew**	**Turnstone**
Annelida											
Oligochaeta			X						X		
Phyllodocidae	X	X	X			X	X		X		
Hediste diversicolor	X	X	X	X	X	X	X	X	X	X	X
Nephtyidae	X	X	X			X	X		X		X
Scoloplos armiger	X	X	X			X	X		X		X
Pygospio elegans	X	X	X			X	X		X		X
Spio martinensis	X	X	X			X	X		X		X
Cirratulidae	X	X	X			X	X		X		
Capitellidae	X	X	X			X	X		X		
Arenicola marina (casts)				X		X					
Crustacea											
Crangon crangon	X						X			X	
Urothoe poseidonis											
Bathyporeia spp.											
Corophium arenarium	X						X		X	X	X
Corophium volutator	X						X		X	X	X
Mollusca											
Retusa obtusa											
Mytilus edulis						X			X		X
Cerastoderma edule		X	X	X	X	X		X		X	
Macoma balthica	X	X	X	X	X	X	X		X	X	
Scrobicularia plana		X									
Peringia ulvae			X	X	X		X	X	X		

3.2.7. Disturbance

Estuarine birds are known to be affected by disturbance to some extent. Disturbance can be defined as any event that disrupts behaviour of bird communities or individual birds. Disturbance can occur naturally, e.g. disturbance caused by predators. However, this section focuses on anthropogenic disturbance.
Disturbance may occur to both feeding and roosting birds, and may be caused by a wide variety of recreational activities and other human activities. A large number of studies have identified activities causing disturbance.

3.2.7.1 Activities causing disturbance – general

Walking and dog walking

Walking and dog walking (including birdwatching) are among the most common and widespread activities carried out on British estuaries (Davidson & Rothwell 1993), and therefore are likely to cause the majority of potential disturbance events. Although most individual instances of disturbance from these activities may be relatively minor, the impact will potentially be greater when a larger number of disturbances occur.

A study of Sanderlings in Florida found that the number of people within 100m was the most important factor explaining the variability in time spent actively foraging, and that day time foraging time decreased over the period of the study after the number of people increased dramatically, with more foraging taking place at night (Burger & Gochfeld 1991).

Dogs can be especially disturbing (Davidson & Rothwell 1993), particularly free running dogs which can cause substantial disturbance at both roost sites and feeding sites. For example, in a study of Sanderlings in California they were found to be the most significant negative factor (Thomas *et al.* 2003).

Recreational water-based activities

Water-based recreational activities may include sailing, water-skiing, jet-skis, motorboats, kayaking and windsurfing. Like walking and dog walking, observational studies have found that water based activities may cause disturbance at high tide roost sites (e.g. Burton *et al.* 1996; Holloway 1997). Water based activities may also cause more disturbance to feeding waders than approaches from land as many waders feed on the mud close to the tide line (Davidson & Rothwell 1993).

Water-based activities also have the potential to affect species which normally forage at sea and are normally less prone to disturbance than birds using other habitats. For example, a study in Iberia found that tourist boats displaced Shags from the best feeding areas and also affecting foraging time by provoking avoidance behaviour (Velando & Munilla 2011).

Aircraft

Aircraft may have particularly marked effects on waterfowl, especially slow flying aircraft (Davidson & Rothwell 1993). In the Wadden Sea, Knot were found to be strongly affected by the presence of both jet fighters and light aircraft. On days when aircraft were present, Knot were rarely present in large numbers and were more likely to take flight at longer distances at the approach of human observers, or for no apparent reason (Koolhas *et al.* 1993). In another study, following radio-tagged Redshank in the Cardiff Bay area, one site was entirely avoided by day, probably due to disturbance

from an adjacent heliport, but was used by many birds at night when the heliport was unused (Burton & Armitage 2005).

Other studies have shown variable levels of response to aircraft which may depend in part on the altitude of the plane and also on differing levels of habituation (Smit & Visser 1993). A different study on the Wadden Sea found that military jets had a relatively mild effect on roosting birds in spite of the associated high sound levels, and that helicopters caused more disturbance and caused birds to take flight at greater distances than military jets (Visser 1986 in Smit & Visser 1993). Heinen (1986 in Smit & Visser 1993) also found that helicopters were the most disturbing aircraft type at a shorebird roost (causing disturbance in 100% of potentially situations), followed by jets (84%), small civil aircraft (56%) and motor gliders (50%).

Wildfowling

Hunting can have an impact on bird populations through direct mortality, but the effect of disturbance caused by hunting may also be important. An investigation into the declines of 154 species of *Anseriformes* (geese, ducks and swans) found that hunting did not influence population trends (Long *et al.* 2007). At a more local scale, a review of wildfowling on the Stour estuary, England, concluded that there was no evidence that the favourable conservation status of any species was being affected by hunting (Musgrove *et al.* 2001). However, a study in North Wales found that the estimated survival rate of Curlews increased slightly after hunting was banned in 1982, and longevity increased by at least 40% (Taylor & Dodd 2013). Similarly, Ebbinge (1991) attributed the increased populations of three goose species in western Europe to decreased mortality rates caused reduced levels of shooting, and also suggested that spatial distribution is affected by shooting, with geese concentrated on better protected areas rather than heavily hunted areas.

Displacement of birds away from hunted areas has also been noted by other studies. In Nebraska, a greater percentage of geese and ducks were recorded on wetlands closed to hunting than in hunted wetlands (Webb *et al.* 2011), and in Findhorn Bay, waterfowl had a greater escape distance from general disturbance during the wildfowling season, and use of some areas increased after the end of the season (Holloway 1997). In an experimental study in Denmark, the impact of hunting disturbance was tested by setting up two reserves: Over five years, these became two of the most important staging areas for wildfowl (Madsen 1995).

Construction work

Construction work on or adjacent to an estuary will also cause aural and visual disturbance to birds. Major construction work can reduce densities, or exclude birds from some intertidal areas, during the construction phase (and sometimes post construction). At Cardiff Bay, Burton *et al.* 2002c) showed that construction work significantly reduced the densities of four species on the adjacent mudflat; Teal, Oystercatcher, Curlew and Redshank.

On the Humber Estuary, the effects of disturbance during construction work at Salt End were studied by the Institute of Estuarine and Coastal Studies (Cutts *et al.* 2009). The amount of disturbance to feeding waders varied according to the level and type of construction activity. They found that the highest levels of disturbance occurred when plant or personnel were on the mudflat itself, with high to moderate levels of disturbance occurring when personnel were on the seaward toe and face, or intermittently present on the crest. The presence of other parties (i.e. non-construction workers) on the seawall also caused high to moderate disturbance, as did irregular piling noise above 70 dB.

Cutts *et al.* (2009) state: "Ambient construction noise levels should be restricted to below 70dB(A), birds will habituate to regular noise below this level. Where possible sudden irregular noise above 50dB(A) should be avoided as this causes maximum disturbance to birds. However data availability is poor for differing noise sources, receptors and times of year, and it is suggested that in order to strengthen predictive capacities (and reduce necessary precautionary factors), a detailed study programme be initiated to provide a more rigorous scientific basis to thresholds."

Noise

The vast majority of research looking at anthropogenic noise and birds has focused on urban areas and how noise levels can cause songbirds to change their songs and/or the time at which they sing (e.g. Halfwerk & Slabbekoom 2009; Fuller *et al.* 2007). Fewer studies have looked at the effect of noise on foraging and roosting birds. As found by Cutts *et al.* (2009) when looking at construction activity, most studies have found that irregular and/or louder noises cause more disturbance than quiet and/or regular noises. Kusters & van Raden (1998) found that the impact of noise on a military shooting range depended on the order in which weapons were fired, with waterfowl and shorebirds showing less reaction if lower dB noise shooting occurred first. They also found that stronger reactions occurred when birds were closely grouped together in larger flocks, such as when they were roosting. An experimental study on the Humber also demonstrated stronger behavioural responses to increased noise levels for the four species studied (Common Gull, Golden Plover, Lapwing and Curlew) (Wright *et al.* 2010).

Other activities causing disturbance

Other activities that have been observed to cause disturbance include roads and railway lines (Burton *et al.* 2002a), bait-digging (Townshend & O'Connor 1993); military activity (Cutts *et al.* 2009); and horse-riding, angling and bathing/general beach use (Davidson & Rothwell 1993).

3.2.7.2. Assessing the impacts of disturbance

Disturbance can vary in magnitude, frequency, predictability, space or duration (Cayford 1993), and the associated impacts on individual birds and species will therefore vary accordingly. Whilst it is clear from the literature that birds on estuaries are disturbed to some extent by human activity, it is more difficult to assess the actual impact that disturbance may have on individual birds or at a site or population level (e.g. Davidson & Rothwell 1993; Hill *et al.* 1997 in Burton *et al.* 2002a).

Disturbance whilst foraging

Where disturbance is only temporary, it may not have any impact on the survival of species using the site. This will depend on how much foraging time is lost and how much extra energy expenditure occurs because of disturbance, and whether individual birds can compensate (Davidson & Rothwell 1993). Where alternative habitat is available, or birds can quickly return to a feeding area after a disturbance, most birds may be able to overcome the effect of disturbance by increasing food intake rates (Swennen *et al.* 1989 in Davidson & Rothwell 1993), and/or extending the length of time that they feed (Davidson & Rothwell 1993). However, forcing birds to move around the estuary to a greater extent than they would do normally may be in conflict with the conservation objectives of the site.

In some instances, minor levels of disturbance may therefore have little long-term effect. A field study of Oystercatchers found that the birds did not need to increase intake rates to make up for disturbances of 30-60 minutes, but instead spent longer feeding (Urfi *et al.* 1996). Similarly,

Riddington *et al.* (1996) calculated that Brent Geese on the North Norfolk Coast would need to feed for up to one hour at night in midwinter to balance their energy budget as a result of disturbance.

However, birds' ability to extend feeding times may be limited. Many estuarine birds can only feed during low tide when mudflats are uncovered, and this limiting factor becomes more important in cold weather when there is a need to feed for longer periods to meet energy requirements. Some species need to feed for longer than others to meet their energy requirements, and so are more susceptible to the effects of disturbance during cold weather. The Redshank is particularly susceptible to disturbance in severe weather as it feeds on very small prey relative to its size (Clark *et al.* 1993; Mitchell *et al.* 2000). Like Redshank, Grey Plover is also highly vulnerable to severe winters, and mortality rates also increase significantly for Knot, Dunlin and Curlew (Clark 2004). Some species may overcome the limitation by using other habitats to find food. For example, fields adjacent to estuaries provide important feeding habitat for Curlew over winter (Townshend 1981).

Displacement from feeding sites

Sometimes birds leave the immediate area after disturbance. This will not necessarily have a significant effect on the overall numbers of birds using the site, if suitable habitat is available elsewhere for the duration of the disturbance. However, sustained disturbance may result in the effective long term loss of an area of feeding habitat (Cayford 1993).

Regular disturbance may therefore cause a reduction in the number of birds that an area can support, known as the 'carrying capacity' of a site. Where an area is close to its carrying capacity, the availability of prey may also become a limiting factor, leading to a need to increase feeding time and to more competition between individuals even when disturbance does not occur; hence the potential for disturbance to have more impact (Cayford 1993).

Burton *et al.* (2002a) used generalized linear models to test whether the number of birds using different count sectors on six English estuaries varied according to a number of factors, including the proximity of the sector to the nearest footpath access point. Six of the nine species considered were found in significantly lower numbers where a footpath was close to the count sector (Shelduck, Knot, Dunlin, Black-tailed Godwit, Curlew and Redshank). Count numbers were also reduced by the proximity of railway lines (Brent Goose, Shelduck and Grey Plover) and roads (Ringed Plover, Grey Plover and Curlew). This suggests that disturbance may be reducing the number of birds using certain sectors within these estuaries.

Disturbance and displacement at roosting sites

Most recreational activity usually takes place at or close to the high tide line, and hence roosting birds are often more vulnerable to disturbance, as they are usually gathered in large flocks close to the high water mark, whereas foraging birds are often spread out over a wide area of mudflat, and further away from most human activities (e.g. Davidson & Rothwell 1993; Holloway 1997; Navedo & Herrera 2012).

Although disturbance at a high tide roost site does not cause birds to stop feeding, it impacts on them by causing increased energy expenditure. In some cases, the impact may be relatively minor and birds will return to the same roost after being disturbed; however in other cases disturbed birds have been observed flying to other roost sites or leaving a site altogether (e.g. Kirby *et al.* 1993; Burton *et al.* 1996). Therefore, regular disturbance at roost sites may cause population declines even if sufficient food resources remain available in an area. In Portugal, declines in wintering populations

of Dunlin, Grey Plover and Redshank on the Tagus estuary were linked to the loss and degradation of roost sites due to human activities (Catry *et al.* 2011).

Predictive models

A number have studies have used predictive models to assess the effect of disturbance and other factors on species abundance. Individual based models use information from behavioural studies to try to predict how individual birds respond to environmental changes including disturbance, based on factors including their feeding rates, choice of prey and foraging area, and time spent foraging, and how these vary as a result of other factors including disturbance, changes in prey abundance and competition (e.g. Goss-Custard *et al.* 2006).

Some individual based models suggest that the impact of disturbance may be substantial. A model predicting the effect of disturbance on breeding Ringed Plover along a 9-km stretch of coastline in The Wash predicted that the population would increase by 85% if there was a complete absence of human disturbance, but would decrease by 23% if human disturbance doubled from current levels. Demonstrating the high degree of variation in sensitivity of species to disturbance, another behaviour based model predicted that the impact of disturbance on Oystercatchers on the Exe estuary was potentially more damaging than permanent habitat loss, with numerous small disturbances being worse than a few large disturbances (West *et al.* 2002). However, current levels of disturbance on this estuary were not expected to cause increased mortality, and preventing disturbance during late winter practically eliminated the impact of disturbance on the population (West *et al.* 2002).

In the Baie de Somme, France, where Oystercatchers were also the subject of the research, modelling predicted a critical threshold of 1.0-1.5 disturbances per hour in good feeding and wintering conditions, with fitness expected to reduce at higher disturbance levels and some birds being at risk of dying of starvation. However, in severe weather or in instances where food resources were scarce, the critical threshold reduced to 0.2-0.5 disturbances per hour (Goss-Custard *et al.* 2006).

Behavioural responses to disturbance

Many species also vary in how they respond to instances of disturbance. For example, Oystercatcher will often walk away from the source of disturbance, whereas Redshank and Curlew will stop feeding and fly away if the source approaches too closely; these differences may relate to the more cryptic plumage of the latter two species (Fitzpatrick & Bouchez 1998).

Different species may also allow people to approach more closely before taking flight. Some studies have attempted to quantify which species are more prone to disturbance relative to others by measuring their reactions to disturbance or the 'escape distances' (i.e. the distance at which they take flight). Often, smaller species allow a closer approach than larger species (Laursen *et al.* 2005) but there are some exceptions, e.g. Oystercatcher is usually less prone to take flight than Redshank (Table 27).

However, escape distances may be extremely variable, and some commentators have suggested that they may not be a good measure to use to assess the sensitivity of individuals or the vulnerability of a species to disturbance (e.g. Gill *et al.* 2001). Factors that influence the flight distance may include flock size, visibility and wind force as well as the type of disturbance itself (Laursen *et al.* 2005). It should also be noted that escape distance is only one of the reactions to disturbance that should be

considered when evaluating disturbance. Other reactions include increased vigilance, stress behaviour such as alarm calling, reduced feeding rates.

Responses may also relate to the starvation risk of avoiding disturbance. A study by Stillman & Goss-Custard (2002) found that Oystercatchers approach a disturbance source more closely and return to a site more quickly after disturbance during late winter, when food abundance is lower and they need to spend more time feeding to meet their energy requirements,. They suggest that this may sometimes mean that species with stronger behavioural responses to disturbance may not always be particularly vulnerable, and that the most sensitive species are those with *both* long escape distances *and* a need to spend a high proportion of their time feeding.

Table 27. Relative responses to disturbance between species (based on several cited studies).

Species	Cutts *et al.* (2009)	Burton *et al.* (2002a)	Davidson & Rothwell (1993)	Kirby *et al.* (1993)	Wright *et al.* (2006)	Van der Meer (1985) in Smit & Visser (1993)	Koepff & Dietrich (1986) in Smith & Visser (1993)
	Level of species sensitivity in Assessment for the Humber estuary (winter)	***Level of tolerance when approached***		***Level of response to disturbance at roost*****	***Tolerance to impulsive noise***	***Mean distances at which birds took flight when approached by people walking across tidal flat***	***Mean distances at which roosting waders took flight when approached by kayaks/ windsurfers***
Brent Goose			"more nervous"			105m	
Shelduck	Moderate to Low					148m	200m/380m
Wigeon	Moderate						
Teal	Moderate						
Oystercatcher	Moderate to Low		"less nervous"	Medium		85m	50m/140m
Ringed Plover	Moderate			Low		121m	
Grey Plover	Moderate			High		124m	
Golden Plover	High				"middle tolerance"		
Lapwing	Moderate to Low				"least tolerant"		
Knot	High			High			275m/210m
Sanderling	Moderate			Low			
Dunlin	Moderate	"most tolerant"	"less nervous"	High		71m	
Black-tailed Godwit	High*	"most tolerant"					
Bar-tailed Godwit	Moderate		"more nervous"	High		107m	200m/240m
Curlew	Moderate	"least tolerant"	"more nervous"	Medium	"most tolerant"	211m	230m/400m
Redshank	High	"most tolerant"	"more nervous"	Low			190m/280m
Turnstone	High*		"less nervous"			47m	

*Black-tailed Godwit was defined as highly sensitive in Cutts *et al.* (2009) due to its status as a Red-listed species rather than due to a known sensitivity to disturbance, and Turnstone due to having specific habitat requirements and a limited range on the Humber estuary.

**For Kirby *et al.* (1993): HIGH – species most likely to leave estuary when disturbed; MEDIUM – most likely to move to other roosts within the estuary but outside the study area; LOW – more likely to stay at the same roost or move to another roost within the study area.

#Distances are approximate as source report is in graphical form and exact distances are not stated.

Habituation

The impact of low-level disturbance may be lower if it occurs regularly and is predictable (e.g. walkers staying on footpaths). In such cases, birds may show habituation to disturbance and allow a closer approach than birds are not habituated. For example, Urfi *et al.* (1996) studied three sites with differing levels of disturbance and found evidence that Oystercatchers reduce the distance at which they took flight when people were present more frequently, which they attributed to habituation.

Some birds may not become habituated to disturbance, for example birds at a military range at Vlieland on the Dutch Wadden Sea did not habituate to shooting activities despite the fact that they had occurred for forty years, though this may have been due to particularly high sound levels in this case (Smit & Visser 1993).

Which activities cause most disturbance?

As behavioural responses to disturbance vary due to a number of factors, it is difficult to assess which types of activity cause more disturbance than other. In some instances, the cumulative effect of minor disturbances may be greater than a single large disturbance.

As discussed above, recreational activities such as walking may have little effect on bird populations in the long term, if they are relatively infrequent. However, some types of activity may cause higher levels of disturbance. Davidson & Rothwell (1993) considered aircraft as the most disturbing human activity, especially slow moving aircraft such as helicopters, microlights and light aircraft. Other activities that cause particular disturbance that are referred to by Davidson & Rothwell (1993) are moving people and animals on the intertidal area (especially dogs) and close approaches to mudflats from the water.

A study of wader roost sites at Hartlepool found that disturbances from helicopters, rats, raptors and boats were more likely than other factors to cause roosting birds to move to another roost site (Burton *et al.* 1996). Escape distances (Table 27) also suggest that water-based activities usually cause stronger responses than walkers, although the measurements are from different studies so are not necessarily directly comparable.

Since 2010, a desk study and two field based surveys have been carried out by Footprint Ecology Ltd to assess potential disturbance activity on the Humber (Cruickshanks *et al.* 2010; Fearnley *et al.* 2012; Ross & Liley 2014). The first two reports identified areas around the Humber with high levels of recreational activity where potential disturbance to birds could be occurring, while the third survey monitored bird responses to potential disturbance events at ten different locations around the estuary.

3.2.7.3. Potential disturbance activities on the Humber Estuary

In a sensitivity analysis for the Humber estuary, Cutts *et al.* 2009 attempted to assess the severity of activities in relation to their effect on birds on the estuary (Table 28).

Table 28. Activities in order of severity of disturbance to waterbirds on the Humber (based on Cutts *et al.* 2009).

Response level	Activity
HIGH	Jets (particularly low flying) Subsonic transport aircraft Free running dogs within 100m
HIGH TO MODERATE	Irregular construction noises above 70 dB Other construction activities (personnel on site)
MODERATE	Shooting (wildfowling and military) Recreational activity (walking, running, dogs) within 100m Boat disturbance within 100m Regular construction noise 50-70dB
LOW	Recreational activity (walking, running, dogs) outside 100m Noise below 50dB

Cruickshanks *et al.* (2010) listed a large number of shore-based activities causing concern in terms of bird disturbance include walking, dog walking, horse riding, cycling, bird and seal watching, beach recreation, wildfowling, motorised access and recreation, samphire picking, angling and bait digging. Out on the water, motor cruising and personal watercraft including jet skis as well as yachting and kite surfing are all activities on the increase. In terms of air-borne recreation, there are a number of airfields and flying clubs which operate around the Humber. A range of private aircrafts regularly fly over the estuary, often at low altitude, including micro-lights, helicopters and small planes. The report highlighted that there were still gaps in understanding about visitor usage around the Humber that that detailed survey work was required, although they attempted to quantify the pressure by using local knowledge and received questionnaire response from local experts including WeBS counters and used this to assess the frequency of disturbance activity in the different WeBS sectors (supplementary report).

Fearnley *et al.* (2012) undertook visitor surveys and vantage point counts of visitor activities and identified areas where visitor activity occurs close to important areas for birds (though the study did not measure actual disturbance so does not confirm that disturbance is occurring). Dog walking was the main activity undertaken by questionnaire respondents, with most people arriving by car but living nearby. Walking was the most popular activity observed during the vantage point counts, with Cleethorpes, Donna Nook, Hessle and the tip of Spurn having the highest concentrations of activity during these counts. A number of key areas were identified where visitor data coincides with key areas for birds, though no assessment of actual disturbance was undertaken at these sites or elsewhere (Table 29).

Table 29. Areas where visitor data coincides with key areas for birds; adapted from Fearnley *et al.* (2012)

Location	Area	Activities	Bird species and activity
Saltfleetby	Outer South	Dog walkers; walkers	Hen harrier roost Sanderling feeding
Saltfleet	Outer South	Bait digging; wildfowling; Dog walkers	Feeding Brent Geese Sanderling feeding
Donna Nook	Outer South	Walkers and dog walkers	Feeding Brent geese; Golden plover roost/feeding area
Horseshoe Point, the Fitties, Northcoates Point	Outer South	Dog walkers	Autumn/winter Golden plover & Lapwing feeding sites/roost
Horseshoe Point, the Fitties, Northcoates Point	Outer South	Kite surfers	Tern roost (late summer) and Brent goose feeding areas (winter)
Horseshoe Point, the Fitties, Northcoates Point	Outer South	Wildfowling	Areas used by Brent geese and also autumn/winter Golden plover & Lapwing feeding and roost sites.
Cleethorpes	Outer South	Dog walkers; walkers; kite surfers; horse riders	Wader roosts
Pyewipe	Middle Humber	Anglers; Dog walkers	Feeding and roosting waders (both sides of sea wall). Particularly important for Black-tailed Godwit Nov-Jan. Many Shelduck now remain here to moult.
Halton Marshes	Middle Humber	Dog walking; Walking; Wildfowling; fishing	In vicinity of fields/marshes used by feeding/roosting Golden plover, Ruff, Lapwing and Curlew. Also key area for Short-eared Owls.
Waterside; Pasture Wharf; Far Ings	Middle Humber; Inner Humber	Dog walking; Walking; Wildfowling	The pits/marshes (inland of seawall) support breeding birds including Marsh harrier, Bittern and Avocet; winter/feeding area for a number of duck
Read's Island; Read's Island Flats	Inner Humber	Wildfowling; Dog walkers along shore; Sailing in channel	Breeding Avocet and Marsh harrier; in winter range of species including Pink-footed goose roost.
Winteringham Haven area	Inner Humber	Wildfowling; Dog walking; Walking	Autumn roost site for Golden plover, Lapwing, Ringed plover, Dunlin and Curlew.
Alkborough Flats	Inner Humber	Dog walkers; Walkers, Joggers; Wildlife watching; Wildfowling	Area important for breeding birds (including Avocet), wintering and passage birds
Faxfleet/Whitton Island	Inner Humber	Wildfowling; Dog walking	Breeding birds (including Marsh harrier and Avocet), winter roost and feeding area in winter for range of wildfowl and waders.
Paull area	Middle Humber	Dog walking; Walking; Fishing	Feeding Black-tailed godwit in the autumn and winter roost and feeding site for Redshank, Lapwing

Location	Area	Activities	Bird species and activity
			and Golden plover.
Cherry Cobb Sands	Middle Humber	Relatively low numbers of shore based access (dog walking, walking); Wildfowling	Winter feeding/roosting by large numbers of waders on fields/marshes (Golden Plover and Lapwing) and on intertidal area.
Stone Creek	Middle Humber	Wildfowling; Dog walking; Walking. Also an anchorage point.	Salt marsh is important for Short-eared owl in winter
Patrington/Easington	Outer North	Dog walking; Walking; Wildfowling; Bait digging (relatively low levels of access)	Hen harrier/raptor roost; high tide wader roost and large expanse of mudflat important for feeding waders.
Beacon Lagoons	Outer North	Beach activities; Wildlife watching	Little tern colony and wader roost site.
Spurn Head	Outer North	Bait digging; Walking, Wildlife watching	Head holds wader roost and intertidal areas are used by feeding waders.

Ross & Liley (2014) undertook fieldwork at ten locations around the Humber to record levels of recreational activity, counts of birds and responses of birds to disturbance. They found that dog walking was the most common activity, with one third of the dog walking events observed involving dogs off the lead. By far the busiest location in terms of human activity was Cleethorpes Leisure centre, with the next busiest location (Humberston Fitties) recording less than a quarter of the events at Cleethorpes.

A summary of the recreational activities recorded by Cruickshanks *et al.* (2010), Fearnley *et al.* (2012) and Ross & Liley (2014) is shown in Table 30.

Table 30. Summary of some of the activities occurring around The Humber Estuary that could potentially disturb bird populations, largely based on questionnaire responses from local experts (Cruickshanks *et al.* 2010) and vantage point surveys (Fearnley *et al.* 2012; Ross & Liley 2014). Detailed maps of disturbance activity can be found in these three reports (provided as annexes to the main report in the first two instances).

Activity	Description
Walking	Occurs around most of the estuary, with most activity at Cleethorpes and several other areas in the Outer South area, at Spurn Head (Outer North), Salt End and Goxhill Marsh (Middle Humber), either side of the Humber Bridge at Hull and Barton (Inner Humber/Middle Humber) and at Alkborough (Inner Humber) (Cruickshanks *et al.* 2010; Fearnley *et al.* 2012; Ross & Liley 2014).
Dog walking	Cleethorpes is where the most dog walking takes place, with other areas including Donna Nook; Saltfleet; Saltfleetby and Theddlethorpe to Mablethorpe North End (all Outer South area), and also at Salt End (Middle Humber) and either side of the Humber Bridge (Inner Humber/Middle Humber) (Cruickshanks *et al.* 2010; Fearnley *et al.* 2012; Ross & Liley 2014).
Angling	Sites with the most activity include; Cleethorpes (Outer South); Spurn Head and Patrington/Easington (Outer North); Salt End; Immingham Docks and Pyewipe (Middle Humber); and Hessle to Hull (Inner Humber) (Cruickshanks *et al.* 2010; Fearnley *et al.* 2012). Angling at Pyewipe was identified by Fearnley *et al.* (2012) as a potential risk to waders especially Black-tailed Godwit. An online questionnaire in Fearnley *et al.* (2012) asking the question 'Where do you fish' suggested angling activity was higher on the north bank than the south, particularly between Salt End and Patrington/Easington.
Horse riding	There are a small number of areas where horse riding occurs. Fearnley *et al.* (2012) identifies horse riding at Cleethorpes as a potential risk to wader roosts.
Birdwatching	Widespread around the estuary, especially at Spurn Head (Outer North); Goxhill to New Holland (Middle Humber) and Barton to Chowder Ness, Barton Cliff, Alkborough and Blacktoft Sands (all Inner Humber) (Cruickshanks *et al.* 2010; Fearnley *et al.* 2012).
Cycling	Sites with the most activity include Pyewipe, Immingham Docks and Barrow to Barton Foreshore (Middle Humber) and Barton Cliff (Inner Humber) (Cruickshank *et al.* 2010).
Motorised recreation	Recorded as very frequent at Barton Cliff (Inner Humber) and Goxhill to New Holland (Middle Humber), and frequent at Pyewipe and Halton Marshes (Cruickshanks *et al.* 2010).
Wildfowling	A small number of events were recorded by Ross & Liley (2014). Wildfowling is known to occur at a number of locations around the estuary, including between Faxfleet andBrough, along the length of the Ouse, opposite Alkborough realignment, at Barton Clay-pits, in some areas between Skitter Ness and East Halton Skitter, along the middle/outer north bank from Stone Creek to Easington Haven, and on the outer beyond Cleethorpes (T. Page, pers. comm.).
Beach activities	Traditional beach activities occur mainly in the Outer South area, being recorded as very frequent at Cleethorpes North Promenade, Saltfleet and Theddlethorpe to Mablethorpe North End, and regular at Tetney to Humberston Fitties and Theddlethorpe to Saltfleetby; also regular at Spurn Head (Outer North) (Cruickshanks *et al.* 2010).

Activity	Description
Water-based activities	According to questionnaire responses, the highest level of disturbance from water based activities occurs at Spurn Head (Outer North), and Read's Island Flats (Inner Humber) (Cruickshanks *et al.* 2010). Yachting and sailing mainly occur in the Inner Humber area and the inner part of the Middle Humber area. This activity was very frequent at Whitton Island Sand (Inner Humber) and frequent at South Ferriby and Blacktoft Sands (both Inner Humber) and New Holland to Barrow (Middle Humber) (Cruickshanks *et al.* 2010). Jet skiing and power boating is most frequent at Blacktoft Sands and Sector B1 (both Inner Humber).
Boat traffic	In addition to above, small-medium cargo vessels using the estuary can produce wash that disturbs birds off the water and off the banks, particularly travelling towards Goole along the narrower parts of the Humber and Ouse (T. Page, pers. comm.).
Kite-surfing	Fearnley *et al.* (2012) map three kite surfing routes starting from Humberston Fitties and covering parts of the Humberston Fitties and Cleethorpes North Promenade sectors.
Airborne activities	According to questionnaire responses, airborne activity as highest at Somercoates to Donna Nook, Horseshoe Point to Tetney Haven (Outer South); Goxhill Marsh and Killingholme Marshes and Barrow to Barton Foreshore (Middle Humber), and Barton to Chowder Ness (Inner Humber). However, disturbance from airborne activity was rated as being highest at Cherry Cobb Sands (Middle Humber) and Reads Island Flats (Inner Humber) (Cruickshanks *et al.* 2010).
Bait-digging	Most frequent at Spurn Head (Outer North). Also occurs at Patrington to Easington (Outer North), and at Tetney Haven to Humberston Fitties, both Horseshoe Point sectors and Theddlethorpe to Saltfleetby (all Outer South) (Cruickshanks *et al.* 2010; Fearnley *et al.* 2012).
Samphire collecting	Frequent at Donna Nook (Outer South), and also occurs at Somercoates to Donna Nook and Cleethorpes North Promenade (both Outer South) and at Spurn Head (Outer North) (Cruickshanks *et al.* 2010).

Bird responses on the Humber

During the study by Ross & Liley (2014), a significant negative relationship between the number of birds at the end of the survey visit and the number of people recorded during the survey occurred across all sites, and the authors suggested that this indicated that localised flushing was causing birds to vacate particular areas temporarily.

There was a large variation in the behavioural response at different sites, with only 5% of events causing birds to take flight at Cleethorpes (the busiest location), but 69% of events causing birds to take flight at Saltfleet (Ross & Liley 2014).

The activities which caused the strongest behavioural responses were wildfowling, birds of prey, air-borne crafts and boats, though these were recorded infrequently in comparison with other activities. If the frequency of occurrence is accounted for, dog-walking stands out, accounting for over half of all disturbances that caused birds to flush. Dogs off leads made up 31% of all recreational events observed, but caused 40% of the flushing events recorded (Ross & Liley 2014).

A range of factors influenced whether or not birds were flushed by human activity (Table 31).

Table 31. Factors influencing whether or not birds were flushed by human activity during observational surveys at ten sites around the Humber estuary. Reproduced from Ross & Liley (2014):

- There were significant differences between sites, with Saltfleet notable in having a high probability of access resulting in birds being flushed
- There was a higher probability of an event resulting in birds being flushed in January compared to October
- There was a higher probability of birds being flushed when temperatures were low (unless below freezing, when there was a low probability of birds taking flight).
- The probability of birds being flushed at low tide was lower than at high tide.
- The probability of birds being flushed declined with distance (i.e. how far away the activity was from the bird), such that the probability of birds being flushed when activities are beyond 100m away is very low.
- Foot/bike activities had the lowest probability of causing birds to take flight.
- Considering the grouping of people on foot or bike, there was a significantly higher probability of birds being flushed if dogs were present. For foot/bike activities the probability of birds being flushed increased with the number of dogs off a lead, but the number of dogs on a lead was not significant.
- There was a significantly higher proportion of flight responses on weekend survey days, compared with weekdays.
- The proportion of flight responses was greater in larger flock sizes.

Most of these findings are broadly in line with other research on disturbance, which have identified disturbance at roosts as a major issue.

The report also assessed the different responses between species to potential disturbance events (Fig. 4). Wildfowl were more likely to show a behavioural response than waders. The responses for waders generally do not agree with previous research which suggests that larger species often show a stronger behavioural response to disturbance than smaller species. However, the findings of previous studies have been very variable and therefore suggest that species' responses may be unpredictable and difficult to measure.

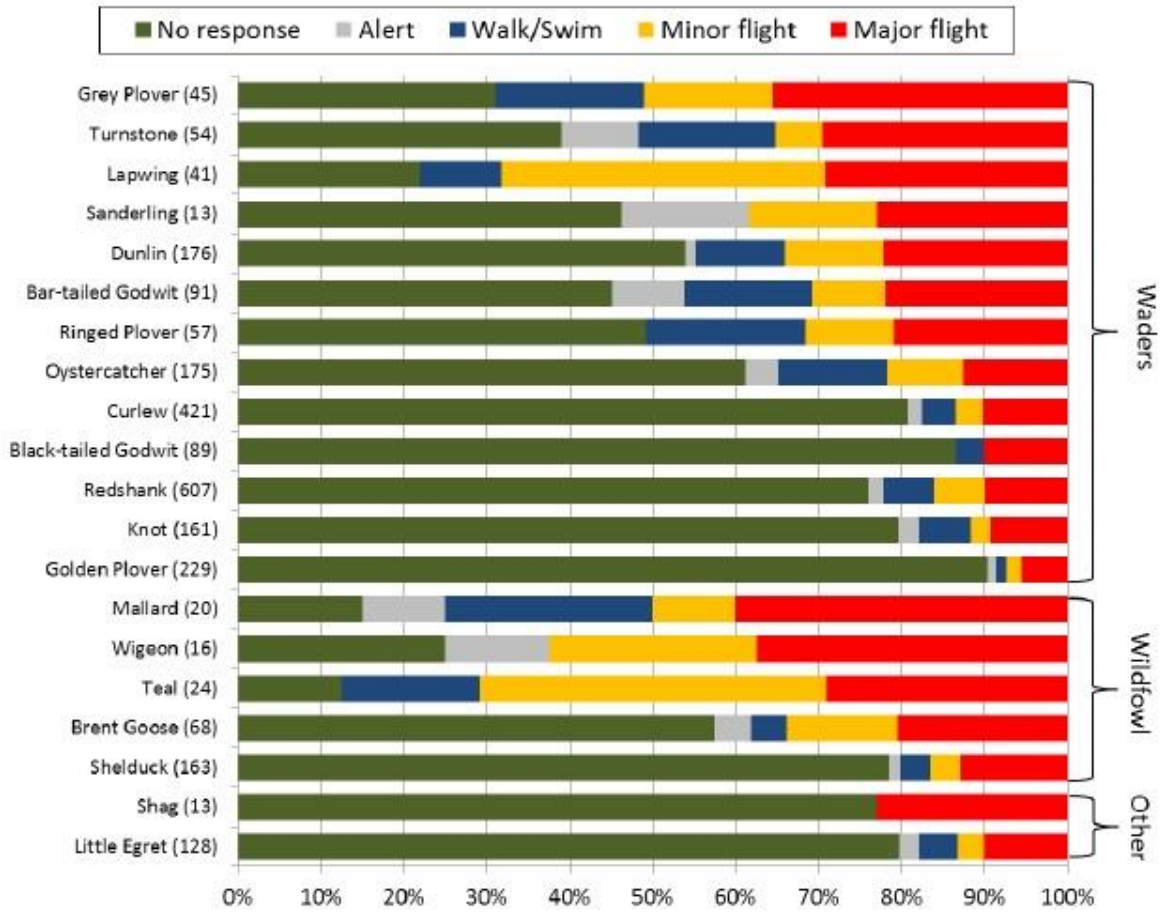


Figure 4. Response to disturbance by species, reproduced from Ross & Liley (2014). Percentages calculated using total number of potential disturbance events for each species. Results within groups are ordered by the % of major flight responses. Numbers in brackets indicate the total number of responses recorded for each species

3.2.8. Managed realignment

Managed realignment involves moving back the flood defences in order to allow an area to be inundated by the tide. Over time, this area will develop into intertidal mudflats, salt marsh or other habitats. In recent years, it has been increasingly used as a method of flood defence management, and also to provide compensation for intertidal habitats lost as a result of development. It is expected to continue to be used as an important management tool in the future (Thomas, 2014).

The Humber Estuary Coastal Management Plan includes managed realignment as one of the tools to compensate for losses of intertidal habitat that are predicted to occur as a result of climate change and habitat losses due to construction and maintenance within the estuary (Black & Veatch 2005). Some 600 ha of new habitat is considered to be required due to the effects of climate change, and some 717 ha of new habitat is required in total (Black & Veatch 2005). These predictions cover the period 2000 to 2050, and therefore the management plan also highlights that continued monitoring of habitat area, habitat quality and sea level rise within the estuary. It will be important to review the assumptions on which the proposals are based, with a review of actual losses after 20 years (i.e. in 2020) being suggested (Black & Veatch 2005).

A number of managed realignment schemes have already been carried out in the Humber, by the Environment Agency as part of the flood defence strategy and in response to coastal squeeze and by

Associated British Ports (ABP) in compensation for direct habitat losses due development. Further schemes are planned (Hemingway *et al* 2008) (Table 32).

Table 32. Summary of planned and proposed Managed realignment schemes on the Humber. Adapted from Hemingway *et al.* (2008); itself adapted from EA (2008a).

Site	Area	Likely Completion Date*
ENVIRONMENT AGENCY SCHEMES		
Paull Holme Strays	Middle Humber (North bank)	Completed in 2003
Alkborough	Inner Humber (South bank)	Completed in 2006
Donna Nook	Outer Humber South	2010*
Skeffling	North bank	Between 2010 and 2020
Welwick	North bank	After 2020
Goxhill	Middle Humber (South bank)	Medium to long term
ASSOCIATED BRITISH PORTS (ABP) SCHEMES		
Welwick	North bank	Completed June 2006
Chowder Ness	South bank	Completed July 2006
OTHER SCHEMES		
Cherry Cobb Sands#	Middle Humber (North bank)	Compensation site for proposed development of Humber Energy Marine Park

*Actual completion dates will depend on actual habitat losses.

3.2.8.1. Managed realignment Case Study 1: Paull Holme Strays

This was the first managed realignment site and was breached in 2003, creating 80 ha of new intertidal habitat. A ten year monitoring programme was established and funded by the Environment Agency to look at factors such as accretion, saltmarsh development, benthic invertebrate community development and bird usage (EA 2008b in Mander 2012). The monitoring programme has generated a large number of interim reports, including a comprehensive study of the site carried out just under a year after breaching, which collected detailed baseline data including records of topography, water quality, habitat and flora, sediments, and infauna and nekton samples (Robertson 2004).

The scheme has been summarised in both Franco & Mazik (2012) and Manson & Pennington (2012a). The initial target for the site was to create 45 ha of mudflat and 35 ha of saltmarsh, i.e. 56% mudflat and 44%

saltmarsh (Manson & Pennington 2012a). However, estimates from aerial images in 2007 were 64% mudflat and 36% saltmarsh, and in 2010 estimates from mapping suggested there was 46% mudflat and 54% saltmarsh (Manson & Pennington 2012a). The site is still accreting and vegetation is still spreading across the saltmarsh, and it is expected that most of the site will develop into saltmarsh in the longer term (Hemingway *et al.* 2008; Franco & Mazik 2012; Manson & Pennington 2012a).

The faunal community has large numbers of relatively small organisms but low numbers of species, and can be considered typical of a middle estuary area (Franco & Mazik 2012). A substantial increase in invertebrate abundance outside the managed realignment site occurred between 2008 and 2010. Over time the abundance, diversity and biomass inside the site has also increased, and the species composition inside and outside the site has reached a higher degree of similarity, but abundance still remains lower inside the managed realignment site and a high degree of variation in community structure still occurs between different parts of the site. Hence the communities inside the site are still not considered to be fully developed (Franco & Mazik 2012).

The usage of the site by birds has also been monitored and numbers of Golden Plover have exceeded the threshold for national and international importance in some years, The site is also particularly important for roosting and loafing Black-tailed Godwit in early autumn, though their numbers fluctuate outside this period at Black-tailed Godwits prefer the pits and mudflat at Killingholme in mid-winter (Mander 2012). Although the mudflat and saltmarsh development has not occurred as planned, Manson & Pennington (2012a) concluded that the managed realignment scheme generates a positive impact for many ecosystem services including 'biodiversity'.

3.2.8.2. Managed realignment Case Study 2: Alkborough Flats

Alkborough Flats is located in the Inner Humber and was breached in 2006 (Hemingway *et al.* 2008). As at Paull Holme Strays, monitoring programmes have generated a large number of reports, some of which compare information across the different areas within the site.

The main purpose of the Alkborough scheme was to provide flood protection by storing water, and hence reduce peak water levels in the estuary. Therefore no specific habitat targets were set for the site, and it is thought unlikely that the site will develop a diverse and abundant benthic invertebrate community. (Manson & Pennington 2012b). In 2011-12, the benthic community structure was found to more diverse inside the realignment than outside on the established mudflats. However, this was due to the development of habitats that support freshwater species, and the estuarine species richness was similar inside and outside the site, though comprised of different species in each area (Mazik *et al.* 2013). The poor estuarine species richness is partly due to the location of the site in the Inner Humber where diversity is lower, and also because a narrow single breach means that flooding is irregular (Mazik *et al.* 2013). Alkborough is also a large site in comparison with other schemes. An initial rapid accretion rate occurred followed by stabilisation, and the rate has decreased since 2010. The site was colonised relatively rapidly by marsh vegetation probably due to its high tidal elevation, although it still cannot be considered fully established (Mazik *et al.* 2013). Although the aim of the site was to provide flood defence rather than habitat replacement to compensate for coastal squeeze, the site has provided new habitat and attracted a large number of birds for feeding and roosting (Mazik *et al.* 2013). However, despite a projected 25 year lifespan, by 2014 the site has already lost 40% of its mud within the inundation area through reed and Sea Aster expansion and looks set to be 90% reed by 2021.

The success of Managed Realignment schemes

A substantial amount of academic work has been undertaken to understand the processes that cause the different types of habitat to be created following realignment, and to assess whether these will provide equivalent habitat to natural sites (e.g. Mossman *et al.* 2012). Mander *et al.* (2013) highlighted that five

years after the creation of the new area at Paull Holme Strays, a study of feeding behaviour of Redshank showed that prey intake and success rate (intake divided by number of pecks and probes) on the newly restored mudflat was lower than on the adjacent mudflat. Although samples had been taken from only a single station in each area**,** there was lower mean benthic abundance and less variety in the restored mudflat (Mazik *et al.* 2009). Mander *et al.* (2013) suggested that feeding behaviour should be included in the assessment of restoration success of intertidal areas as a measure of habitat quality. Pertinently, Mazik *et al.* (2013) conclude that newly created wetlands only offer a poor substitute for lost habitat.

3.2.9. Factors operating outside the SPA – implications of climate change

Wintering wader and waterfowl communities have been regularly counted by Wetland Bird Survey (WeBS) surveyors on a monthly basis at a wide range of sites, particularly large estuaries and wetlands, to provide population trends for most species that date back to the mid-1960s (e.g. Holt *et al.* 2012). International Waterbird Census counts provide additional data from across Europe. These data have already provided increasing evidence that recent climate change has impacted on the distribution and communities of waders wintering in the UK and across Europe. The distribution of 8/9 common estuarine waders (Charadrii) within the UK is linked to temperature, with fewer birds occupying western estuaries during mild winters (Austin & Rehfisch, 2005), an effect particularly apparent in species of small body size. Distributions of three wader species that winter on open coasts have shown similar shifts through time (Rehfisch *et al.*, 2004). Across northwest Europe there has been a significant north-easterly shift in the wintering distribution of six wader species from January 1981 to January 2000 of 75 – 119 km in extent (Maclean *et al.* 2008). Here, the strongest responses of population size to temperature were most apparent at the coldest sites.

More detailed analyses of French data have shown that these changes have been associated with significant changes in community composition at each site. From 1977 to 2009 populations of species which tend to be associated with warmer winter climates have tended to increase in abundance relative to those that occupy cooler climates. This change is equivalent to a 20 km northwards shift in community composition per year (Godet *et al.* 2011). Probably linked to these shifts, there has been a significant increase in species-richness of the wader communities on British estuaries over the same period (Mendez *et al.* 2011). Several hypotheses have been proposed to account for these changes. Firstly, they are likely to partly reflect changes in overwinter survival rates. Periods of severe (cold, wet) winter weather are known to have cause increased mortality of waders (Clark 1982, 2004, 2009, Peach *et al.* 1994, Insley 1997, Catchpole *et al.* 1999, Piersma *et al.* 2005), and therefore, increasing winter temperatures, at least to 2009, are likely to have increased survival rates, potentially accounting for the recently increasing populations in the coldest locations occupied by particular species observed by Maclean *et al.* (2008). However secondly, the rapidity of the observed shifts suggests that they may also be driven by the movement of individuals (Austin & Rehfisch 2005, Maclean *et al.* 2008). In particular, the increasing proportion of individuals from a range of species wintering on eastern estuaries, which tend to be colder, but more productive, probably means that birds have been able to take advantage of feeding on those sites for longer, with reduced risk of mortality as a result of severe weather (Austin & Rehfisch 2005).

Although wintering waders tend to exhibit a relatively high-degree of site-fidelity (Rehfisch *et al.* 1996, Pearce-Higgins 2001), they may make cold-weather movements in response to severe weather, and the observed shifts may reflect a decreasing preponderance to do so in recent years. A north-east directional shift is likely to have been responsible for concurrent increases in numbers of coastal waterbirds wintering in The Netherlands, particularly at the principal site of the Wadden Sea. It is pertinent therefore, that four of the five wader species whose range centroids were shown by Maclean *et al.* (2008) to have shifted in the period 1980-2000, increased in the UK in a short spell of recent cold winters, such as November 2010 to January 2011 (Holt *et al.* 2012). Such shifts can be explored by use of regional WeBS trends; the change has

been most marked in the eastern England region (which includes important estuaries such as The Wash, Humber Estuary and Breydon Water). This recent pattern is indicative of birds wintering slightly further south and west than had typified the period of milder winters when a greater proportion of birds were probably wintering on the continent.

Furthermore, the observed shifts may reflect increasing patterns of juvenile settlement at more northern or north-eastern sites as they become increasingly suitable in response to climate change. Observed changes in the winter distribution of an expanding black-tailed godwit population in the UK illustrate the importance of such juvenile settlement in driving increasing colonisation of otherwise unoccupied sites (Gunnarsson *et al.* 2005). Although, similar analyses have not been undertaken for coastal or marine wildfowl, there is evidence that increasing numbers of many species are taking advantage of ice-free waters in the Baltic countries, waters formerly unavailable throughout much of the winter while they remained frozen. In the Baltic, the wintering distribution of many species has shifted northwards in recent years (Nilsson 2005, 2008). Declines in Velvet Scoter and Long-tailed Duck recorded from the eastern coast of Scotland may reflect this process, although widespread population declines of both species have also occurred (BirdLife International 2012). This has been demonstrated in mallard, some of which winter around the UK coast, although many occupy inland wetlands. As expected, long-distance winter movements of this species are related to cold weather, and have decreased in frequency in recent years (Sauter *et al.* 2010) leading to fewer individuals from eastern Scandinavia wintering on eastern English coasts (Gunnarsson *et al.* 2012). Further evidence for climate change impacts on the migratory behaviour of waterbirds comes from Lehikoinen & Jaatinen (2012), who show that the timing of autumn migration of 6 / 15 wildfowl has been delayed in response to warming, and may underpin northwards shifts in the wintering distribution of these species. Species whose UK winter populations comprise birds from more than one biogeographic breeding population may show differential regional trends according to their origin. For example, numbers of wintering Slavonian Grebes are increasing in Shetland and west Scotland (a sub-population presumed to be of Icelandic origin), whereas the species has decreased on the south and east coasts of England (a sub-population considered more likely to be of Scandinavian breeding origin.

Other groups of waterbirds also make regular use of coastal sites, including herons. The Little Egret has expanded northwards from Europe, both in terms of population size and distribution, in the last 20 years. Populations at estuaries in northern England are now expanding at similar rate to those which typified south coast sites 15 years ago. The species may expand into Scotland if climate allows. Other herons, such as great white egret, cattle egret and glossy ibis, all of which use estuaries in winter, are showing signs of increasing in the UK. Many of our wintering waders and waterbirds breed in Arctic and subarctic regions that have experienced some of the greatest warming trends around the world in recent years. They are therefore potentially vulnerable to additional impacts of climate change outside of the UK. Recent evidence suggests that changes in the timing or abundance of invertebrate food resources in the Arctic may affect wader productivity (e.g. McKinnon *et al.* 2012), whilst recent destabilisation of lemming cycles in the Arctic will significantly affect predator populations, with potentially significant impacts on wader and waterfowl productivity, which have previously been tied to such cycles. However, there is little evidence for these processes impacting on wintering wader and waterfowl populations in the UK to date, although this could be due to a lack of specific research in this area, which should be addressed as a high priority. In addition to climate change, migratory waterbird populations are vulnerable to a range of other pressures and processes. In particular, excessive harvesting by shellfisheries have led to significant reductions in oystercatcher mortality and declines in knot, shelduck and oystercatcher populations on the Wash (Atkinson *et al.* 2010). Potentially disentangling these processes from those relating to climate change may be difficult, particularly given likely interactions between the two processes. The effect of severe winter weather on Oystercatcher mortality was greatest in years of low shellfish abundance (Atkinson *et al.* 2003). Similarly, coastal development leading to habitat loss may also reduce the condition and survival of displaced birds, even if they move elsewhere (Burton *et al.* 2006). Ensuring appropriate attribution of climate change impacts on these populations is therefore important, but challenging.

3.3. STAKEHOLDER CONSULTATION

3.3.1. Summaries of Natural England workshops

See Appendices 1-2 for summaries of the relevant workshops pertaining to this report.

3.3.2. Identification of threats and drivers of change

We listed all the threats and pressures identified in the original Natural England workshops, attempting to list as discrete threats those which might be site specific in nature.

This list was developed into a matrix to facilitate the collection of quantitative data (see 3.3.2.1 below).

Matrices were sent out to a number of people within the Humber Estuary SPA stakeholder community. These included representatives from Natural England, RSPB, IECS, Humber partnership, and the wildfowling community.

Returned data were collated prior to undertaking telephone interviews aimed at gleaning further information and discussing particular issues originally highlighted by the Natural England workshops and subsequently identified by the matrix exercise.

Identified pressures on species across the Humber Estuary SPA

All threats were scored at different spatial scales. Tables 33-36 show the mean scores per species in terms of the four main areas of the Humber Estuary – Inner, Mid, Outer North and Outer South. Factors were scored by 0 if factor not present; 1 if factor present, but considered to cause no impact; 2 if factor present and considered to cause slight impact on that species/group; 3 if factor present and considered to causes moderate impact; 4 if factor present and considered to cause marked impact, and 5 if factor present and considered to cause severe impact.

Therefore, if two responses scored a factor as 1 and two further responses scored the same factor as 5, the mean score would equal 3. Hence, if there happened to be strong divergence of opinion among stakeholders on particular issues, these opinions would be balanced out using this objective approach.

Inner

Factor	Pink-footed Goose	Dark-bellied Brent Goose	Shelduck	Wigeon	Mallard	Teal	Pochard	Scaup	Goldeneye	Oystercatcher	Golden Plover	Lapwing	Ringed Plover	Black-tailed Godwit	Bar-tailed Godwit	Curlew	Turnstone	Knot	Ruff	Sanderling	Dunlin	Greenshank	Redshank	wildfowl	waders
Accretion and growth of vegetation on the intertidal	1	1	2	3	2	2	1	1	1	1	3	3	2	2	1	2	1	1	1	1	4	2	4	1	2
Availability of high tide roosts	1	0	0	0	0	0	0	0	0	1	2	2	2	1	1	1	1	1	1	0	2	1	2	0	2
Bait digging	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Birdwatchers	1	1	1	2	2	2	1	1	1	1	2	2	1	2	1	2	1	1	1	1	2	1	2	1	1
Boat traffic	2	1	1	2	2	2	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1
Change in prey availability	1	1	2	2	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	1	3	1	3	1	2
Changes in discharges (both quality and quantity)	0	0	1	0	0	0	1	0	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	0	1
Changes in invertebrate communities			2		1	1								1	1	1					2		2	1	1
Changes in species balances																								0	1
Climate change	1	0	2	2	3	2	2	1	1	1	2	2	2	1	1	2	1	1	2	1	2	2	2	1	1
Direct damage to habitat features through harvesting / collection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Disturbance and access	2	0	2	2	2	2	1	0	1	1	2	2	1	1	1	2	1	1	1	0	1	1	2	1	1
Non-native and feral species	1	0	1	2	2	2	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1
Habitat and morphological change	2	0	3	3	2	2	1	0	1	1	3	3	3	2	2	2	1	1	1	0	4	1	3	2	2
Flood risk																								1	1
Industrial development	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
Kayaking and kayak angling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kite surfing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lack of good hinterland habitat	2	0	2	3	3	2	1	0	1	1	3	3	1	1	1	3	1	1	2	0	2	2	2	2	2
Land drainage and associated dredging	1	0	1	2	2	2	1	0	1	1	2	2	1	1	1	2	1	1	1	0	1	1	1	2	2
Land use and farming practice	2	1	2	3	3	3	1	1	1	1	3	3	1	2	1	3	1	1	2	1	2	2	2	2	2
Low flying aircraft	1	0	1	1	1	1	1	0	1	1	2	2	1	1	1	2	1	1	1	0	1	1	1	1	1
Managed realignment and other habitat creation	1	1		2	2	2	1	1	1	1	3	3	1	2	1	2	1	1	2	1	1	1	1	1	2
Motor bikes and dog walking	2	1	2	3	2	2	1	1	1	1	3	3	2	2	1	3	1	1	1	1	2	1	2	2	2
Recreation	1	0	1	1	1	2	1	0	1	1	2	2	1	1	1	1	1	1	1	0	1	1	1	1	1
Redevelopment of previously developed land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea angling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tidal generation and solar PV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wildfowling	3	1	2	3	3	3	1	1	1	1	2	2	1	2	1	2	1	1	1	1	2	1	2	2	1
Windfarm development	1	0	1	1	1	1	1	0	1	1	2	2	1	1	1	1	1	1	1	0	1	1	1	1	2

Waders			Wildfowl	
Accretion and growth of vegetation on the intertidal	28		Wildfowling	18
Habitat and morphological change	27		Land use and farming practice	17
Land use and farming practice	25		Motor bikes and dog walking	15
Change in prey availability	24		Accretion and growth of vegetation on the intertidal	14
Motor bikes and dog walking	24		Climate change	14
Lack of good hinterland habitat	23		Habitat and morphological change	14
Climate change	22		Lack of good hinterland habitat	14
Managed realignment and other habitat creation	21		Boat traffic	13
Birdwatchers	20		Birdwatchers	12
Wildfowling	20		Disturbance and access	12
Availability of high tide roosts	18		Change in prey availability	11
Disturbance and access	17		Managed realignment and other habitat creation	11
Boat traffic	16		Non-native and feral species	10
Land drainage and associated dredging	16		Land drainage and associated dredging	10
Low flying aircraft	16		Industrial development	9
Recreation	15		Recreation	8
Windfarm development	15		Low flying aircraft	7
Industrial development	14		Windfarm development	7
Non-native and feral species	13		Changes in invertebrate communities	4
Changes in discharges (both quality and quantity)	12		Changes in discharges (both quality and quantity)	3
Changes in invertebrate communities	7		Availability of high tide roosts	1
Bait digging	0		Bait digging	0
Changes in species balances	0		Changes in species balances	0
Direct damage to habitat features through harvesting / collection	0		Direct damage to habitat features through harvesting / collection	0
Flood risk	0		Flood risk	0
Kayaking and kayak angling	0		Kayaking and kayak angling	0
Kite surfing	0		Kite surfing	0
Redevelopment of previously developed land	0		Redevelopment of previously developed land	0
Sea angling	0		Sea angling	0
Tidal generation and solar PV	0		Tidal generation and solar PV	0

Table 33. Identified pressures affecting non-breeding waterbirds on the Inner Humber. Scores are the summed mean scores shown in the above matrix.

MID

Factor	Pink-footed Goose	Dark-bellied Brent Goose	Shelduck	Wigeon	Mallard	Teal	Pochard	Scaup	Goldeneye	Oystercatcher	Golden Plover	Lapwing	Ringed Plover	Black-tailed Godwit	Bar-tailed Godwit	Curlew	Turnstone	Knot	Ruff	Sanderling	Dunlin	Greenshank	Redshank	wildfowl	waders
Accretion and growth of vegetation on the intertidal	1	2	2	1	1	1	1	1	1	1	3	3	3	3	3	3	2	2	1	1	3	1	3	1	2
Availability of high tide roosts	1	0	1	1	1	1	0	0	1	0	3	3	3	2	2	3	1	2	0	0	3	0	3	1	2
Bait digging																								0	0
Birdwatchers	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Boat traffic	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Change in prey availability	1	1	2	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	1	1	2	1	2	2	1
Changes in discharges (both quality and quantity)																								1	2
Changes in invertebrate communities																								2	2
Changes in species balances																								1	1
Climate change	1	1	2	2	2	2	1	1	1	1	1	1	2	1	2	1	2	2	1	1	2	1	1	1	2
Direct damage to habitat features through harvesting / collection	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Disturbance and access	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	1	2	1	1	2	1	2	1	1
Non-native and feral species	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	1	1	2	1	2	1	1
Habitat and morphological change	1	1	3	1	1	1	1	1	1	1	2	3	3	3	3	3	2	2	1	1	3	1	3	1	2
Flood risk																								1	1
Industrial development	1	1	2	1	1	1	1	1	1	1	2	2	2	3	2	2	2	1	1	1	2	1	2	1	2
Kayaking and kayak angling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Kite surfing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lack of good hinterland habitat	1	0	1	1	1	2	0	0	0	0	3	3	3	3	0	3	0	0	2	0	2	0	2	2	2
Land drainage and associated dredging	1	0	1	1	1	1	0	0	0	0	1	1	1	1	1	1	0	1	1	0	1	0	1	2	2
Land use and farming practice	2	0	1	2	2	1	0	0	0	0	3	3	2	2	1	2	0	1	2	0	2	0	2	2	2
Low flying aircraft	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Managed realignment and other habitat creation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Motor bikes and dog walking	1	1	1	2	1	1	1	1	1	1	2	2	1	2	1	2	1	1	1	1	1	1	1	1	2
Recreation	1	0	1	1	1	1	0	0	1	0	1	1	1	1	1	1	0	1	0	0	1	0	1	1	1
Redevelopment of previously developed land																									
Sea angling	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Tidal generation and solar PV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wildfowling	1	0	2	2	2	1	0	0	1	0	1	1	0	1	0	1	0	0	0	0	1	0	1	1	1
Windfarm development	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Waders	
Accretion and growth of vegetation on the intertidal	32
Habitat and morphological change	31
Availability of high tide roosts	25
Industrial development	24
Non-native and feral species	23
Change in prey availability	22
Disturbance and access	21
Lack of good hinterland habitat	21
Land use and farming practice	20
Climate change	19
Motor bikes and dog walking	18
Birdwatchers	14
Boat traffic	14
Low flying aircraft	14
Managed realignment and other habitat creation	14
Sea angling	14
Land drainage and associated dredging	10
Recreation	9
Wildfowling	6
Bait digging	0
Changes in discharges (both quality and quantity)	0
Changes in invertebrate communities	0
Changes in species balances	0
Direct damage to habitat features through harvesting / collection	0
Flood risk	0
Kayaking and kayak angling	0
Kite surfing	0
Redevelopment of previously developed land	0
Tidal generation and solar PV	0
Windfarm development	0

Wildfowl	
Climate change	13
Accretion and growth of vegetation on the intertidal	11
Habitat and morphological change	11
Change in prey availability	10
Industrial development	10
Motor bikes and dog walking	10
Birdwatchers	9
Boat traffic	9
Disturbance and access	9
Non-native and feral species	9
Low flying aircraft	9
Managed realignment and other habitat creation	9
Sea angling	9
Wildfowling	9
Land use and farming practice	8
Availability of high tide roosts	6
Lack of good hinterland habitat	6
Recreation	6
Land drainage and associated dredging	5
Bait digging	0
Changes in discharges (both quality and quantity)	0
Changes in invertebrate communities	0
Changes in species balances	0
Direct damage to habitat features through harvesting / collection	0
Flood risk	0
Kayaking and kayak angling	0
Kite surfing	0
Redevelopment of previously developed land	0
Tidal generation and solar PV	0
Windfarm development	0

Table 34. Identified pressures affecting non-breeding waterbirds on the Mid Humber. Scores are the summed mean scores shown in the above matrix.

OUTER NORTH

Factor	Pink-footed Goose	Dark-bellied Brent Goose	Shelduck	Wigeon	Mallard	Teal	Pochard	Scaup	Goldeneye	Oystercatcher	Golden Plover	Lapwing	Ringed Plover	Black-tailed Godwit	Bar-tailed Godwit	Curlew	Turnstone	Knot	Ruff	Sanderling	Dunlin	Greenshank	Redshank	wildfowl	waders
Accretion and growth of vegetation on the intertidal	1	2	2	1	1	1	0	0	1	3	2	2	2	2	3	2	2	3	1	2	3	2	2	2	3
Availability of high tide roosts	1	1	1	1	1	1	0	0	0	3	2	2	2	2	3	2	2	3	1	2	2	2	3	1	3
Bait digging	1	1	1	1	1	1	0	0	1	1	1	1	1	1	2	2	1	2	1	1	2	1	2	1	2
Birdwatchers	1	2	1	1	1	1	0	0	1	2	2	2	1	1	2	2	1	2	1	1	2	1	2	2	2
Boat traffic	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Change in prey availability	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	2
Changes in discharges (both quality and quantity)	0	0	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Changes in invertebrate communities	0	1	1	1	1	1	0	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
Changes in species balances	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Climate change	1	2	2	2	2	2	1	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Direct damage to habitat features through harvesting / collection	0	1	1	1	1	1	0	1	1	1	1	1	1	1	2	2	1	2	1	1	2	1	2	1	2
Disturbance and access	1	2	1	1	1	1	0	1	1	2	2	1	2	2	2	2	1	2	1	1	2	1	2	2	2
Non-native and feral species	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Habitat and morphological change	1	1	1	2	2	2	0	1	1	2	2	2	2	1	2	2	1	3	1	1	3	1	3	1	3
Flood risk	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Industrial development	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kayaking and kayak angling	0	0	0	0	0	0	0	0	0	1	1	0	0	1	1	0	0	1	0	0	1	0	1	0	1
Kite surfing	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lack of good hinterland habitat	3	3	1	3	3	3	0	1	1	2	4	4	2	2	2	4	2	2	3	1	2	1	3	3	4
Land drainage and associated dredging	1	2	1	1	1	1	0	0	0	1	2	2	1	1	1	2	1	1	2	1	1	1	2	2	2
Land use and farming practice	2	3	1	2	2	2	0	1	1	1	3	3	2	2	2	3	1	1	2	1	2	1	3	3	3
Low flying aircraft	1	2	1	1	1	1	1	1	1	2	2	2	1	1	2	2	1	2	1	1	2	1	2	2	2
Managed realignment and other habitat creation	1	1	1	2	2	2	0	1	1	2	2	2	1	2	2	2	1	2	1	1	2	1	2	1	2
Motor bikes	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Dog walking	1	2	1	2	2	2	0	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Recreation	2	3	1	2	2	2	0	1	1	3	3	2	2	2	3	3	2	3	2	2	3	2	3	2	3
Redevelopment of previously developed land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea angling	1	2	1	1	1	1	0	1	1	2	2	2	2	1	2	2	2	2	1	2	2	1	2	2	2
Tidal generation and solar PV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wildfowling	2	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Windfarm development	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Waders	
Lack of good hinterland habitat	34
Availability of high tide roosts	32
Recreation	32
Accretion and growth of vegetation on the intertidal	29
Dog walking	28
Land use and farming practice	27
Habitat and morphological change	25
Managed realignment and other habitat creation	25
Disturbance and access	25
Sea angling	24
Climate change	24
Change in prey availability	23
Bait digging	22
Low flying aircraft	21
Birdwatchers	21
Changes in invertebrate communities	19
Motor bikes	19
Land drainage and associated dredging	18
Direct damage to habitat features through harvesting / collection	17
Wildfowling	16
Windfarm development	15
Boat traffic	14
Flood risk	14
Changes in discharges (both quality and quantity)	9
Kayaking and kayak angling	5
Changes in species balances	0
Non-native and feral species	0
Industrial development	0
Kite surfing	0
Redevelopment of previously developed land	0
Tidal generation and solar PV	0

Wildfowl	
Lack of good hinterland habitat	16
Land use and farming practice	14
Climate change	13
Recreation	13
Dog walking	12
Change in prey availability	11
Low flying aircraft	11
Sea angling	10
Motor bikes	10
Disturbance and access	9
Accretion and growth of vegetation on the intertidal	9
Managed realignment and other habitat creation	9
Habitat and morphological change	9
Windfarm development	9
Birdwatchers	8
Boat traffic	8
Flood risk	8
Bait digging	8
Availability of high tide roosts	8
Changes in invertebrate communities	7
Wildfowling	7
Direct damage to habitat features through harvesting / collection	6
Land drainage and associated dredging	5
Non-native and feral species	5
Changes in discharges (both quality and quantity)	4
Changes in species balances	1
Industrial development	0
Kayaking and kayak angling	0
Kite surfing	0
Redevelopment of previously developed land	0
Tidal generation and solar PV	0

Table 35. Identified pressures affecting non-breeding waterbirds on the Outer Humber North. Scores are the summed mean scores shown in the above matrix.

OUTER SOUTH

Factor	Pink-footed Goose	Dark-bellied Brent Goose	Shelduck	Wigeon	Mallard	Teal	Pochard	Scaup	Goldeneye	Oystercatcher	Golden Plover	Lapwing	Ringed Plover	Black-tailed Godwit	Bar-tailed Godwit	Curlew	Turnstone	Knot	Ruff	Sanderling	Dunlin	Greenshank	Redshank	Wildfowl	waders
Accretion and growth of vegetation on the intertidal	0	2	3	2	2	2	0	0	0	2	2	2	2	0	2	2	2	3	1	1	3	1	2	1	1
Availability of high tide roosts	0	1	1	1	1	1	0	0	0	2	2	2	3	1	3	2	1	3	1	2	2	1	2	1	2
Bait digging	0	2	2	1	1	1	0	0	0	2	1	1	1	0	1	2	1	2	1	1	2	1	2	1	1
Birdwatchers	0	2	2	1	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Boat traffic	0	1	1	1	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Change in prey availability	0			0	1	1	0	0	0					0	1	1	1		1	1		1	1	1	1
Changes in discharges (both quality and quantity)	0	0	1	0	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Changes in invertebrate communities	0	0	1	0	1	0	0	0	0		1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Changes in species balances	0	1	1	1	1		0	0	0	1	1	1	1	0	1	1	1	1	0	1	1	1	1	0	0
Climate change	1						1	1	1					1	2	2	2	2	1	2	2	2	2	1	1
Direct damage to habitat features through harvesting / collection	0	1	1	1	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Disturbance and access	1	3	3	2	2	2	0	0	0	3	3	2	3	0	3	3	1	3	1	2	3	2	3	1	2
Non-native and feral species	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Habitat and morphological change	0	2	2	3	2	3	0	0	0	2	2	2	2	0	2	2	2	3	1	1	3	2	2	1	1
Flood risk	1	1	1	1	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Industrial development	0	1	1	1	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Kayaking and kayak angling	0	1	1	1	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Kite surfing	0	3	2	2	2	2	0	0	0	3	2	2	3	1	3	3	1	3	1	2	3	2	3	1	1
Lack of good hinterland habitat	1	2	1	2	1	2	0	0	0	2	3	3	1	0	1	3	1	1	1	1	1	1	2	2	2
Land drainage and associated dredging	0	1	0	0	0	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	1	0	1	1	1
Land use and farming practice	1	3	1	2	1	1	0	0	0	2	4	3	1	0	1	3	1	1	1	1	1	1	2	2	2
Low flying aircraft	1	2	2	2	2	2	0	0	0	2	2	2	2	0	2	2	1	2	1	2	2	1	2	1	1
Managed realignment and other habitat creation	1	1	1	2	1	2	0	0	0	1	2	2	1	0	1	2	1		1	1	2	1	2	1	1
Motor bikes and dog walking	1	3	3	2	3	3	0	0	0	3	3	3	4	0	3	3	1	4	1	3	4	2	3	2	2
Recreation	1	3	3	3	3	3	0	0	0	4	3	3	4	0	4	3	1	4	1	3	4	2	4	2	2
Redevelopment of previously developed land	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	1	0	1	1	0	1	0	1
Sea angling	1	1	1	1	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
Tidal generation and solar PV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wildfowling	1	2	2	2	3	2	0	0	0	1	1	1	1	0	1	2	1	1	1	1	1	1	2	1	1
Windfarm development	1	1	1	1	1	1	0	0	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1

Waders	
Recreation	40
Motor bikes and dog walking	37
Disturbance and access	32
Kite surfing	32
Availability of high tide roosts	27
Habitat and morphological change	26
Accretion and growth of vegetation on the intertidal	25
Low flying aircraft	23
Land use and farming practice	22
Lack of good hinterland habitat	21
Bait digging	18
Climate change	18
Managed realignment and other habitat creation	17
Wildfowling	15
Birdwatchers	13
Boat traffic	13
Changes in discharges (both quality and quantity)	13
Direct damage to habitat features through harvesting / collection	13
Flood risk	13
Industrial development	13
Kayaking and kayak angling	13
Sea angling	13
Windfarm development	13
Changes in invertebrate communities	12
Changes in species balances	12
Redevelopment of previously developed land	11
Change in prey availability	7
Land drainage and associated dredging	7
Non-native and feral species	0
Tidal generation and solar PV	0

Wildfowl	
Recreation	16
Motor bikes and dog walking	15
Disturbance and access	13
Habitat and morphological change	12
Wildfowling	12
Accretion and growth of vegetation on the intertidal	11
Kite surfing	11
Low flying aircraft	11
Lack of good hinterland habitat	9
Land use and farming practice	9
Managed realignment and other habitat creation	8
Bait digging	7
Birdwatchers	7
Non-native and feral species	6
Flood risk	6
Sea angling	6
Windfarm development	6
Availability of high tide roosts	5
Boat traffic	5
Direct damage to habitat features through harvesting / collection	5
Industrial development	5
Kayaking and kayak angling	5
Changes in species balances	4
Climate change	4
Changes in discharges (both quality and quantity)	3
Change in prey availability	2
Changes in invertebrate communities	2
Land drainage and associated dredging	1
Redevelopment of previously developed land	0
Tidal generation and solar PV	0

Table 36. Identified pressures affecting non-breeding waterbirds on the Outer Humber South. Scores are the summed mean scores shown in the above matrix.

3.3.3. Fine scale identification of pressures – sector level

All the stakeholders also scored possible drivers of change at the level of WeBS sectors, enabling fine scale identification of factors that may be responsible for changes in bird numbers at the local level. This quantified assessment of factors operating on the estuary was used in combination with specific details reported at the Natural England workshops.

These are related to the sector level trends published by Ross-Smith *et al.* (2013). These data are presented in Appendix 3, and have also been provided in *Excel* format both to aid interpretation and to represent a useful resource for Natural England and others in the future.

The fine scale identification of potential drivers was dependent on the received feedback from the consulted stakeholders and therefore may reflect personal views.

4. DISCUSSION AND RECOMMENDATIONS

4.1. Species overviews – summaries and inferred drivers of change

Bird species overviews are presented below in tabular form organised as follows:

- ***Status***: A statement of whether or not there are any current issues associated with the species in question on the Humber Estuary.

- ***Inferred drivers of change on the Humber Estuary***: Here we list those issues identified directly from the literature review or deduced through the consultation exercise. These are based on our assessment of the knowledge available. However, in most cases the inferred drivers are speculative and it is likely that a range of issues have contributed to the changes for most species.

- ***Potential future issues on the Humber Estuary***: Here, based on species traits and their know sensitivities to particular issues in a broader context, we shortlist issues that could be of concern in the future should there be any change from the *status quo*.

- ***Gaps in knowledge***: Here we list important knowledge gaps that were they to be addressed would lead to increased confidence in our assessments regarding potential drivers of change. It is combined with an assessment of the quality of current evidence that underpins our suggestions for drivers of change on the Humber.

- ***Recommendations***: Here we make recommendations to address issues identified above.

4.1.1. Pink-footed Goose

STATUS	No current concern: Stable trend. Dependent on roost site on Read's Island and foraging areas in agricultural hinterland.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Potential re-distribution in hinterland likely to be associated with field use for particular crops.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Any future increase in aircraft activity. Any future increase in recreational activity. Any future loss of food resources, due to habitat loss or crop changes. Any future loss of undisturbed "refuge" areas.
GAPS IN KNOWLEDGE	Lack of specific information for The Humber. In particular: Extent and availability of food resources. Disturbance studies with special attention to quiet "refuge" areas. Lack of site level trend
RECOMMENDATIONS	No immediate measures required. Continue current monitoring. It would be judicious to initiate further work to fill knowledge gaps to provide robust baseline information should issues arise in the future. Incorporation of migratory geese into the WeBS Alerts (process underway)

4.1.2. Dark-bellied Brent Goose (*Branta bernicla bernicla*)

STATUS	No current concern: Stable trend. However, a re-distribution of Brent Goose flocks has occurred in the Outer South area where the majority of Brent Geese on the Humber are found.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Reasons for re-distribution are unknown. Disturbance and habitat change are both possible causes.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Any future increase in aircraft activity. Any future increase in recreational activity. Any future loss of food resources, due to habitat loss or "eelgrass disease". Any future loss of undisturbed "refuge" areas.
GAPS IN KNOWLEDGE	Lack of specific information for The Humber. In particular: Extent and availability of food resources. Disturbance studies with special attention to quiet "refuge" areas.
RECOMMENDATIONS	No immediate measures required. Continue current monitoring. It would be judicious to initiate further work to fill knowledge gaps to provide robust baseline information should issues arise in the future.

4.1.3. Shelduck (*Tadorna tadorna*)

STATUS	Medium Alert: Long-term declining population (including in key WeBS sectors), though no change since classification. Trends very variable at sector level.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Unknown. However, an increasing proportion of regional numbers are using the site suggesting that conditions remain relatively favourable on the site. Disturbance is a possible factor behind variable sector trends.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Further changes to habitat extent and quality. Disturbance.
GAPS IN KNOWLEDGE	Reasons for variable sector trends are not well understood.
RECOMMENDATIONS	Prevent mudflat loss. It would be judicious to initiate further work to fill knowledge gaps to provide robust baseline information should issues arise in the future.

4.1.4. Wigeon

STATUS	Medium alert: Declines in short-term, long-term and since classification. Declines are occurring across most sectors, though increases have occurred between Winteringham Haven and Goxhill Marsh
INFERRED DRIVERS OF CHANGE ON THE HUMBER	The evidence suggests that the declines on The Humber probably result from site-specific pressures. Habitat change and disturbance are both possible causes for the declines. Increasing populations of feral/naturalised geese may be affecting Wigeon feeding areas.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Further habitat loss, decline in food availability, especially due to the impact of naturalised goose populations. Disturbance.
GAPS IN KNOWLEDGE	Lack of specific information for The Humber. In particular: Extent and availability of food resources, and impact of geese. Disturbance studies with special attention to quiet "refuge" areas.
RECOMMENDATIONS	Research to fill knowledge gaps to confirm drivers of change and provide recommendations to halt/reverse the declines.

4.1.5. *Teal*

STATUS	No current concern: Substantial increases have occurred since classification.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	The evidence suggests that the increases probably result mainly from broad scale population changes, with regional and UK trends also increasing.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Any future changes to habitat and/or food resources. Disturbance from recreational activity.
GAPS IN KNOWLEDGE	Little information on diet and habitat use on the Humber.
RECOMMENDATIONS	No immediate measures required. Continue current monitoring. Undertake research to fill knowledge gaps to provide robust baseline information should issues arise in the future.

4.1.6. Mallard (*Anas platyrhynchos*)

STATUS	High alert. High alert in the long term and medium alert since classification. Variable sector trends suggesting some redistribution has occurred.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	The evidence suggests that the declines on The Humber probably result mainly from broad scale population changes rather than site-specific pressures, e.g. changes to wintering distribution in Europe. However, declines in food availability (e.g. reduction in grain spillage) may have caused some local declines on the Humber.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Further changes to European wintering distribution. Further habitat loss, decline in food availability.
GAPS IN KNOWLEDGE	Little information on diet and habitat use on The Humber. Declines and redistribution around The Humber are not well understood.
RECOMMENDATIONS	Undertake research to fill knowledge gaps and confirm whether site-specific factors are contributing to the decline.

4.1.7. Pochard

STATUS	High Alert: High alert since classification, and medium alert in the short term. Sector level trends have been variable.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Unknown. The population peaked at the time of classification but otherwise has been relatively low on the Humber. Possible reasons include broad-scale changes to wintering distribution; and reduced food availability as a result of sewage treatment.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Habitat loss, decline in food availability.
GAPS IN KNOWLEDGE	Little information on current diet and habitat use on The Humber, including nocturnal feeding areas.
RECOMMENDATIONS	Undertake research to fill knowledge gaps and confirm whether site-specific factors are contributing to the decline.

4.1.8. Scaup

STATUS	Not included in WeBS alerts. Five year peak mean has fallen from 127 at the time of classification to 80 in winter 2012/13. However, both means misrepresent numbers wintering annually in the SPA. In most years, only very small numbers are recorded, but larger flocks occur in some years, most likely following harsh weather elsewhere. The WeBS counts data indicate that larger flocks occurred more commonly in the 1980s and 1990s.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Unknown. Reduced food availability as a result of sewage treatment has been linked to declines of this species in other areas, and changes to wintering distribution may also have occurred (but substantiated evidence is lacking).
POTENTIAL FUTURE ISSUES ON THE HUMBER	Reduced food availability following improved sewage treatment and declines in waste spillage from dock operations may mean that the site will be less attractive to the species in years when Scaup are displaced by harsh weather from continental wintering areas.
GAPS IN KNOWLEDGE	There is very little information on the reasons why high numbers appear in some years, or about diet and habitat use on the Humber.
RECOMMENDATIONS	Assess previous patterns of occurrence to fill in knowledge gaps, and ensure habitat and food resources are protected so they are available when Scaup are present on the Humber.

4.1.9. Goldeneye

STATUS	Medium alert: Medium alerts have been triggered in the short term and medium term. However, there has been a substantial increase since the 1980s.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Unknown. The SPA is supporting an increasing proportion of regional numbers suggesting that the decline is probably linked to broad-scale population changes to wintering distribution rather than site-specific factors. However, declines in the New Holland/Goxhill Marsh area may be linked to reductions in waste spillage from New Holland Pier operations.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Goxhill to New Holland is the most important sector for this species, and the birds here are thought to rely on waste spillage from dock operations, so any further reductions in spillage may impact on the Humber population.
GAPS IN KNOWLEDGE	Information about diet and habitat preferences away from Goxhill to New Holland, e.g. at Brough to North Ferriby where numbers are currently increasing.
RECOMMENDATIONS	Ensure that suitable habitat is available for this species elsewhere within the SPA, to provide alternative resources if numbers at Goxhill to New Holland continue to decline.

4.1.10. Oystercatcher

STATUS	No current concern: Stable trend. However, sector trends have been variable, particularly in the Outer South area where decreases in some sectors have been offset by increases in other sectors.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Unknown. Several sectors where decreases have occurred have high levels of disturbance so this may be a factor (e,g, Cleethorpes; Donna Nook; Spurn Head). However, habitat and food availability may also be a factor (e.g. increases have occurred at Grainthorpe Haven Pye's Hall to Horseshoe Point where the cockle beds are currently closed).
POTENTIAL FUTURE ISSUES ON THE HUMBER	Habitat loss, decline in food availability.
GAPS IN KNOWLEDGE	Further investigation should be carried out to identify the reasons why variable trends are occurring across sectors and confirm whether disturbance is an important factor in some sectors.
RECOMMENDATIONS	Undertaking research to fill the knowledge gaps should be a high priority. This species is generally regarded as among the least sensitive to disturbance; therefore if it is confirmed that Oystercatcher declines are caused by disturbance in some sectors it is likely that most other species are also being affected.

4.1.11. Golden Plover

STATUS	Medium alert: Short term decline. However, substantial increases have occurred in the long term. Sector level trends variable but with declines in the majority of sectors
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Unknown. Regional and British trends are similar to the site trends so the recent decline may be due to broad scale population changes rather than site-specific factors. Habitat changes or disturbance may also be a factor, both within and outside the SPA boundary.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Habitat loss and further disturbance could both have an effect. This species roosts in the estuary but often feeds in inland and coastal fields, and is therefore also susceptible to changes to agricultural practice and inland developments as well as changes within the SPA itself.
GAPS IN KNOWLEDGE	Detailed studies of feeding areas within NE Lincs have been carried out, but similar studies are not available to identify important inland feeding areas around the rest of the estuary. An assessment of how habitat changes and disturbance may have affected distribution within the SPA would also help to clarify habitat requirements.
RECOMMENDATIONS	Fill knowledge gaps for this species, and ensure that important inland areas are protected. Habitat requirements are broadly similar to Lapwing, so a combined approach could be applied for these two species.

4.1.12. Lapwing

STATUS	High alert. High alert for the decline since SPA designation, and medium alerts have also been triggered by declines in the short term and medium term. However, numbers have doubled in the long term.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Unknown. Numbers have been declining in the region and in Britain, but the proportion of regional birds using the Humber SPA declined during the 1990s suggesting some site-specific factors may also be responsible. Habitat changes or disturbance are both potential drivers of change. Like Golden Plover, Lapwing feeds in inland fields so could also have been affected by changes to agricultural practices outside the SPA.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Habitat loss and further disturbance both within and outside the SPA.
GAPS IN KNOWLEDGE	Detailed studies of feeding areas within NE Lincs have been carried out, but similar studies are not available to identify important inland feeding areas around the rest of the estuary. An assessment of how habitat changes and disturbance may have affected distribution within the SPA would also help to clarify habitat requirements.
RECOMMENDATIONS	Fill knowledge gaps for this species, and ensure that important inland areas are protected. Habitat requirements are broadly similar to Golden Plover, so a combined approach could be applied for these two species.

4.1.13. Ringed Plover

STATUS	High alert. Declines have been sufficiently large to have triggered high alerts for all three time periods measured and also since SPA designation, although increases have occurred in some sectors.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Numbers of wintering Ringed Plover are declining in the region and in Britain suggesting that broad-scale population changes are a driver behind the decline. However, numbers on the Humber are declining at a faster rate which suggests that site-specific issues are also contributing to the decline. Disturbance is a potential factor, as the most important sectors for Ringed Plover are in the Outer South area, where recreational activity is particularly high. Saltmarsh is also increasing in these sectors, which will reduce the extent of suitable sandy habitat available for Ringed Plovers.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Further national population declines may impact on this species. The high levels of recreational activity in the Outer South area are also a potential ongoing concern given the importance of this area for Ringed Plovers wintering within the Humber SPA.

GAPS IN KNOWLEDGE	Dispersal during the non-breeding season is poorly understood so it is unclear where the majority of wintering Ringed Plover originate from and therefore whether problems in the breeding area may be an important driver behind the decline. It is also unclear whether disturbance or habitat change is the most important factor behind sector level declines, particularly in the Outer South area, or whether any other factors may also be involved.
RECOMMENDATIONS	Assess the precise habitat preferences and distribution of Ringed Plovers in the Humber SPA, particularly within the Outer South sectors, to identify (and address wherever possible) the most likely reasons for declines in these sectors.

4.1.14. Curlew

STATUS	No current concern. Substantial increases have occurred in the long term and the trend is stable in the short and medium term. However, sector level trends are variable.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Unknown. Sector level trends are broadly similar to most other wader species suggesting general factors such as disturbance or habitat change are affecting this species. However, this species is increasing in some sectors where most other waders are decreasing (e.g. Brough Haven to North Ferriby; Somercoates to Donna Nook).
POTENTIAL FUTURE ISSUES ON THE HUMBER	Curlew may be affected by predicted losses of mudflats due to climate change, and is also thought to be among the more sensitive species to disturbance so any further increases in recreational activity at roost sites or feeding sites may have an impact.
GAPS IN KNOWLEDGE	Further knowledge into the impacts of disturbance and the precise habitat requirements of this species on the Humber would be beneficial, in particular why numbers are increasing in some sectors where other waders are in decline.
RECOMMENDATIONS	No immediate measures required. However, this species is likely to be affected by similar factors to most other wader species (i.e. loss of intertidal habitat and disturbance), so any research and action to address these factors should benefit this species.

4.1.15. Black-tailed Godwit

STATUS	Medium alert. A medium alert has been triggered in the short term. However, this alert should be viewed with caution as wintering numbers fluctuate, and in fact substantial increases in numbers have occurred in the long term (+827%).
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Numbers overwintering in the region and in Britain have been increasing in the long term, and the proportion of regional birds using the Humber SPA is increasing suggesting that conditions remain suitable for the species and that carrying capacity has not yet been reached.
POTENTIAL FUTURE ISSUES ON THE HUMBER	The potential development at Killingholme is a major threat as this is an important site for the species. Although it is believed that a proposed new managed realignment site will more than compensate for the development (Percival 2011), other research has suggested that previous managed realignment schemes have failed to fully meet habitat objectives, particularly where they have aimed to create intertidal mudflats (section 3.2.8). Other potential future issues include the predicted loss of intertidal mudflats due to climate change, and possible increases to disturbance from recreational activity.
GAPS IN KNOWLEDGE	There is a good knowledge about the distribution and habitat requirements of Black-tailed Godwit on the Humber (Catley 2009; Percival 2011). Research about successfully creating intertidal mudflats through managed realignment schemes is ongoing.
RECOMMENDATIONS	Ensure that the proposed managed realignment scheme is designed using the most up to date knowledge available. Ensure that the other sites used by this species are protected from disturbance, to ensure Black-tailed Godwits have some alternative habitat available during development at Killingholme if the managed realignment scheme fails to provide compensatory habitat in the short term.

4.1.16. Bar-tailed Godwit

STATUS	No current concern. Numbers have increased in the long term and since designation, and are stable in the short and medium term. Sector level trends have been variable.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Unknown. Trends in most sectors are similar to other wader species and may possibly be related to habitat changes or disturbance.
POTENTIAL FUTURE ISSUES ON THE HUMBER	As for other intertidal wader species, potential future issues include the predicted loss of intertidal mudflats due to climate change, and possible increases to disturbance from recreational activity.
GAPS IN KNOWLEDGE	Further knowledge into the impacts of disturbance on this species on the Humber would be beneficial.
RECOMMENDATIONS	No immediate measures required. However, this species is likely to be affected by similar factors to most other wader species (i.e. loss of intertidal habitat and disturbance), so any research and action to address these factors should benefit this species.

4.1.17. Dunlin

STATUS	Medium alert. Declines have occurred in the medium and long term, and also since designation. Sector trends variable with declines recorded in most sectors.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	The proportion of regional numbers of Dunlin using the Humber has remained stable despite declines in numbers wintering in the UK. This suggests that the main driver behind the decline in the SPA is broad-scale population changes, possibly caused by a shift in wintering distribution in response to climate change. The reason for variable sector level trends is unknown. As for other intertidal waders, habitat changes and disturbance are both potential factors.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Further shifts in wintering distribution due to climate change may result in further declines on the Humber. Loss of intertidal mudflats due to climate change, and possible increases to disturbance from recreational activity may make the Humber less attractive in comparison to other UK estuaries.
GAPS IN KNOWLEDGE	Further knowledge into the impacts of disturbance on this species on the Humber would be beneficial.
RECOMMENDATIONS	This species is likely to be affected by similar factors to most other intertidal wader species (i.e. loss of habitat and disturbance), so any research and action to address these factors should benefit this species as well as other species.

4.1.18. Redshank

STATUS	Medium alert. Declines in the short term and medium term have triggered a medium alert for Redshank. Sector level trends are also extremely variable across all parts of the estuary.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Widespread declines in Britain and Europe have occurred and may be one of the drivers behind the decline. However, the proportion of regional birds supported by the Humber SPA is decreasing, suggesting that site-specific factors are also at least partly responsible. The pattern of declines and increases at sector level is difficult to interpret. However, most of the strongest declines have occurred in areas where heavy recreational activity occurs so disturbance is probably a factor. It seems likely that other factors such as habitat changes and food availability may have also contributed to sector level changes.
POTENTIAL FUTURE ISSUES ON THE HUMBER	As for other intertidal wader species, potential future issues include the predicted loss of intertidal mudflats due to climate change, and possible increases to disturbance from recreational activity. Redshank is believed to be particularly susceptible to the effects of disturbance, particularly during more severe weather.
GAPS IN KNOWLEDGE	Further knowledge into the impacts of disturbance and the precise habitat requirements of this species on the Humber would be beneficial.
RECOMMENDATIONS	This species is likely to be affected by similar factors to most other intertidal wader species (i.e. loss of habitat and disturbance), so any research and action to address these factors should benefit this species as well as other species.

4.1.19. Turnstone

STATUS	Of concern? This species is not included in the WeBS alerts. However, comparison of the most recent 5-year peak mean count (365) with the 5-year peak mean count at the time of designation (629) suggests that this species may have declined in the Humber SPA.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Unknown. The apparent decline may be related to broad-scale population changes, as declines in Turnstone numbers shown by the non-estuarine winter shorebird count are thought to have been caused by a northerly range shift brought about by climate change. However, the most important areas for Turnstone on the Humber include a number of sectors subject to high recreational activity, so disturbance is another potential driver. Turnstone is thought to be relatively tolerant compared to other species, but has been defined as highly sensitive to disturbance on the Humber due to its specific habitat requirements and restricted range in the SPA (Cutts *et al.* 2009).

POTENTIAL FUTURE ISSUES ON THE HUMBER	Further distribution shifts or increased disturbance may exacerbate the decline. Loss of habitat may also be a factor. Turnstone uses different habitat to most other wader species (rocky or stony substrata rather than intertidal mud) which may potentially be seen as less valuable as it does not support a wide range of species.
GAPS IN KNOWLEDGE	Further research into the effect of recreational activity on Turnstones on the Humber would help confirm whether disturbance may be a factor driving the decline, and identify key sites for this species in the Humber.
RECOMMENDATIONS	Undertake research to fill the gaps in knowledge. Future site planning should take into account the fact that Turnstone has different habitat requirements from other wader species, and ensure these habitats are protected.

4.1.20. Knot

STATUS	No current concern: Stable trend. Sector level trends have been variable.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Not applicable. Sector level trends have been variable but this species is known to cover extensive areas of mudflat and may therefore be expected to move between different sectors both within and between seasons as feeding conditions vary.
POTENTIAL FUTURE ISSUES ON THE HUMBER	The wintering distribution of Knot may be shifting eastwards due to climate change, which may mean that numbers in the UK will decline in the future as more birds winter in Europe. This species may be particularly susceptible to any loss of intertidal mudflats due to its requirement for extensive areas of mudflat. Knot is also believed to be highly sensitive to disturbance at roost sites. The roost at Easington lagoons holds a high proportion of the Knot on the Humber so any disturbance at this roost may be significant if no other suitable roost sites are available.
GAPS IN KNOWLEDGE	Knots have been well studied on European estuaries so their ecological requirements are reasonably well known. Further knowledge of their favoured feeding and roosting areas on the Humber would be useful (IECS report in prep.), and in particular the identification of actual and potential roost sites that could provide an alternative to Easington lagoons if required. Managed realignment schemes have failed to meet targets to create intertidal mudflats and further research is ongoing in this area.
RECOMMENDATIONS	Continue plans to provide managed realignment sites in compensation for predicted intertidal mudflat losses due to climate change, but ensure that new schemes consider the most recent research available. Limit disturbance at Easington lagoons roost site and other roost sites around the Humber SPA.

4.1.21. Greenshank

STATUS	No current concern? This species is not included in the WeBS alerts. However, comparison of the most recent 5-year peak mean count (68) with the 5-year peak mean count at the time of designation (77) does not suggest any reason for concern.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Not applicable.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Loss of habitat and disturbance could both potentially affect numbers of Greenshank using the Humber SPA.
GAPS IN KNOWLEDGE	More detailed knowledge of habitat requirements on the Humber would be useful.
RECOMMENDATIONS	No immediate measures required.

4.1.22. Sanderling

STATUS	Medium alert. Declines since classification have prompted a medium alert, though the short, medium and long term trends are stable.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	Unknown. The proportion of regional numbers using the Humber SPA has declined since the 1990s, suggesting site-specific factors are driving the decline. Sanderling are found mainly in the Outer South area and at Spurn Head, where recreational activity is high, so disturbance may be an important factor.
POTENTIAL FUTURE ISSUES ON THE HUMBER	This species prefers sandy beaches rather than mudflats and is believed to be sensitive to disturbance especially from dogs, so recreational activity in the Outer South area may cause further declines.
GAPS IN KNOWLEDGE	Detailed knowledge of the areas used by Sanderling would be useful, particularly in the Outer south area. Further research into the effect of recreational activity on Sanderling in these areas would help confirm whether disturbance may be a factor driving the decline, and identify key sites for this species in the Humber.
RECOMMENDATIONS	Undertake research to fill the gaps in knowledge, and consider whether any actions can be taken to limit disturbance at key sites for this species.

4.1.23. Ruff

STATUS	Of concern. This species is not included in the WeBS alerts. However, comparison of the most recent 5-year peak mean count (49) with the 5-year peak mean count at the time of designation (128) suggests that this species may have declined in the Humber SPA.
INFERRED DRIVERS OF CHANGE ON THE HUMBER	The breeding range has shifted eastwards and consequently passage birds are also using a more easterly route and numbers have declined substantially in western Europe. In the Netherlands, this change has been linked to agricultural intensification causing a decline in the condition of passage sites.
POTENTIAL FUTURE ISSUES ON THE HUMBER	Further broad-scale population changes may mean that numbers continue to decline irrespective of what happens in the Humber SPA. However, habitat loss or decline in the quality of habitat within and around the SPA (including inland fields) may contribute to further declines in this species.
GAPS IN KNOWLEDGE	Detailed information about sites used by this species around the Humber SPA is limited.
RECOMMENDATIONS	MacDonald (2009) suggests that set-aside fields and freshwater wetlands, e.g. those north of East Halton Skitter, can provide habitat for Ruff in the South Humber Bank Zone. Provision of similar habitat around the rest of the Humber may benefit Ruff, and will also provide habitat for other species that forage inland including Lapwing, Golden Plover and Curlew.

4.2. Discussion of future prospects – the wider context

Future climate change impacts are likely to affect species on their breeding grounds, passage areas and wintering grounds, making them likely to be particularly sensitive to climate change. Many of the species that winter on the Humber breed in northern Arctic and subarctic environments where warming is projected to be greatest (Wernham *et al.* 2002; Delany *et al.* 2009), and may therefore be particularly vulnerable to change, for example through changes in food resources, predation rates and habitat change. These pressures may indicate that future climate change impacts during the course of this century are likely to reduce the size of the flyway population of many of these species. Precisely how these changes will impact on specific wintering populations will depend on how those individuals redistribute themselves across a changing wintering range.

Future projections of climate change impacts are now available for wintering waterbird populations in the UK as a result of the CHAINSPAN project (Pearce-Higgins *et al.* 2011). Data from France, Ireland, the Netherlands and the UK were used to model the density of 47 wintering waterbird species in response to temperature and precipitation, and used to make projections about how their abundance may change in response to future climate change. Fourteen of the 15 wader species modelled showed positive relationships between winter temperature and density, but negative correlations between summer temperature and density. The same trends were also apparent for wintering waterbirds (including divers and grebes), although less strongly; 14/29 species exhibited positive correlations between density and winter temperature, compared to 5 with negative correlations, and 14 / 29 showed negative effects of summer temperature upon density. Positive relationships between winter temperatures are probably indicative of the negative effects of cold winter weather on the abundance and survival of wintering waders and waterbirds at the site-level outlined in the previous section. They may therefore directly reflect demographic processes, or indicate potential movements in the distribution of individuals in response to climate change. Interestingly, Dalby *et al.* (2013) suggest that temperature has a weak effect on the winter distribution of dabbling ducks in Europe, which may account for the weaker effect of temperature found for waterfowl than waders. Consistent negative effects of summer warming may initially appear difficult to account for, as this is not the period when the birds are present at the sites. However, there is increasing evidence that such lagged effects may be biologically meaningful and operate through effects on site condition, such as through negative effects of warming on prey abundance (see Pearce-Higgins *et al.* 2010).

Based on the models of Pearce-Higgins *et al.* (2011), future projections are for general increases in the abundance of many migratory waterbird populations across the UK in response to climate change. This is due largely to the positive relationship between winter temperature and abundance. Thus 22 wintering or passage waterbird species populations were projected to increase by more than 25 % by 2050 under a medium emissions scenario compared to 10 projected to decline by more than 25 % over the same timeframe. The species for which projected increases were associated with the greatest confidence were Slavonian Grebe, Little Egret, Dark-bellied Brent Goose, Red-breasted Merganser, Ringed Plover, Greenshank, Sanderling and Snipe, whilst Knot was the species with the greatest confidence in climate-change mediated population declines being likely. Although these models are relatively simplistic, and underpinned by a wide-range of assumptions, there is evidence across all the species modelled that recent population trends were correlated with the projected sensitivity of those species to future climate change. Further confidence in the results can be derived from the fact that increases were projected to be most apparent in the north and east, reflecting recent trends with respect to distributional shifts described in the previous section.

In addition to these impacts, climate change is projected to impact on sea-levels through direct thermal expansion, melting ice sheets and increased frequency of storm surges. These changes may reduce the extent of intertidal habitats and saltmarsh (Pethick & Crooks 2000), leading to an estimated 3,000 ha of habitat loss within 100 years (Ausden *et al.* 2011). Whilst the extent of saltmarsh habitats are showing a

strong declining trend around England, this appears largely to result from the interaction between increased storm activity, the re-enforcement of hard coastal defence and land reclamation (Pye 2000, van der Wal & Pye 2004, Wolters *et al.* 2005). Any loss of saltmarsh in response to climate change would potentially also impact on coastal breeding species such as Redshank, whilst loss of shingle breeding areas may affect ringed plovers. Any changes in sea-level are projected to alter the shape of estuaries, with potential implications for their character. At sites where there is no sea-defence, sea-level rise is likely to widen the estuary, increasing wave-action and increasing the grain size of the substrate. This will favour species of sandy rather than muddy sediments (Austin & Rehfisch, 2003). However, where the coast continues to be defended, then the consequences will be more deleterious. For example, at the Humber, a 30 cm rise in sea-level is predicted to reduce the area of exposed mudflat by 7 % but the biomass of invertebrate food by up to 23 %, again depending on changes in sedimentation (Fujii & Raffaelli 2008).

In summary, future warming is likely to improve climatic conditions for many overwintering waders and waterbirds in the UK. This may lead to localised population increases in response to improved overwinter survival. Alternatively, population declines may occur in the UK, as birds increasingly shift north and east to more favourable and productive wintering locations that have previously been too cold. Thirdly, wintering species may be potentially impacted by climate change impacts on the breeding grounds, whilst passage migrants may also be affected by negative impacts of climate change further south. Given the likely magnitude of projected future climate change across the high latitude breeding ranges of many of these species, it is likely that it will be through climate change impacts in the Arctic and boreal regions that the greatest effects of climate change on our internationally important wintering waterbird populations will be manifested. It remains to be seen precisely how numbers on individual SPAs, such as the Humber, will respond.

4.3. Recommendations for future work and management options

We have aimed to relate trends in waterbird numbers across and within the Humber Estuary SPA to activities and environmental changes that are candidates for drivers of population change. We have used local expert knowledge to identify key factors on a species by species basis. Some of these factors, such as global environmental change, might be impossible to mitigate at the local level, but nonetheless help account in part for observed changes. However, it may be possible to address other causes of change through appropriate site management.

Much of the information on potential drivers of change from the literature is at a much broader scale than the information from which WeBS sector-level waterbird trends are derived. Often such information describes the situation across the Humber Estuary as a whole, while others refers to one or more precise locations as a result of the systematic treatment at a within site-level. This has enabled the report to link particular activities, habitat changes *etc*. to sector-level trends in waterbird numbers, and in turn increases the confidence with which we can conclude that particular activities (even if known to affect waterbird numbers in general) are likely to be driving observed changes on the Humber Estuary SPA.

Whilst it is unquestionable that the habitats within the boundary of the SPA itself are of prime importance to waterbirds on the Humber Estuary SPA, habitats outside the boundary are also of high importance to these same birds. The agricultural land behind the sea wall is essential in that it supports high tide roosts for the majority of waders, especially during spring tides. The adjacent fields are also of particular importance for foraging Pink-footed Geese and waders such as Golden Plover and Lapwing.

It must not be forgotten that some of the waterbird declines of concern on the Humber Estuary may be, at least in part, due to broad-scale change such as population declines or re-distribution as a response to global change. This may well be the case for a range of ubiquitous species such as Mallard, Lapwing,

Dunlin, as well as for more habitat-specific species such as Pochard and Scaup. However, although some trends may appear to be following broader scale changes, it is possible that this is coincidental and local drivers of change are important in some cases. Where waterbird numbers on the site are driven by external changes, less suitable areas within the Humber Estuary SPA would be expected to be the first to lose birds. Consequently, numbers will decline on those areas even if pressures on them or across the site as a whole were unchanging.

Massimino et al. (2012) modelled site-based variation in abundance of wintering waterbirds (and other SPA features) on the network of SPAs in the UK. Various assumptions were made with respect to the responses of different species to climate change, but Humber Estuary was not highlighted as a site where trends differed significantly from expected trends based on climate change alone. That study recommended site-based investigations as a follow up to modelled results.

Our study has highlighted several site-based pressures that are likely to be accentuating effects of wider environmental change. If local pressures are driving loss of numbers in particular areas, we would expect relationship between changes in numbers and changes in those pressures. More detailed information is therefore needed on habitat change and food resources at a resolution that can be matched to WeBS sector-level trends in waterbird numbers, in order to fully understand the reasons behind the waterbird declines that have been identified.

We have attempted to address this through use of stakeholder consultation and collection of quantitative data on the importance of individual factors with respect to species' declines. All the consulted stakeholders have a long association with the Humber Estuary, providing a genuine "feel" for what has changed and how this has affected the waterbirds at the finer scale. Analysis of sector level trends shows differences between different parts of the estuary. This consultation has identified a number of potential drivers of change at local level, and most of the gaps in knowledge for individual species to date relate to a lack of detailed information on habitat and food resources at a resolution approaching that of the waterbird count data.

Several studies focusing on disturbance have highlighted the outer south shore of the Humber as a particularly problematic area, confirmed by results of this study. There appear to be strong causal correlations between the presence of recreational activities such as dog walking and use of motorbikes and waterbird trends at the local level. Although this study has not been able to identify strong causal links between disturbance from wildfowling (no quantitative data available) and bird population trends, the stakeholder consultation has drawn attention to possible issues (for wildfowl) in the inner estuary at a number of areas on both the north and south shores. Key areas: Saltfleet, Horseshoe Point, Halton Marshes, Read's Island, Alkborough Flats, Whitton Island, Stone Creek, Patrington/Easington

As well as possible disturbance arising from recreation and wildfowling activities, other pertinent issues within the distinct areas of the estuary identified by the consultation, include accretion and vegetation growth (for waders), accretion and availability of high tide roost sites in the mid estuary, and lack of hinterland habitat/effects of farming on the outer north. We suggest that these represent some of the major issues on which to base future work, either in terms of research and/or collaborative initiatives locally. Associated recommendations and suggestions are highlighted below.

4.3.1 Humber SPA-specific recommendations

Based on the collated outputs of this study, we suggest the following recommendations relating to the Humber Estuary area. All these should be considered within the context that it is an important element of the concept of site integrity that redistribution of birds within the site caused by anthropogenic factors may not be acceptable, even if there is no evidence that numbers across the site as a whole have declined.

Most of the threats and gaps in knowledge highlighted in this report are not species-specific and affect a number of the target species. These recommendations aim to address these generic issues. Further detail on species-specific responses to particular threats and pressures (for example, the potential conflict between naturalised geese and Wigeon) is described in Tables 2-24, which can be referred to when considering actions aimed at particular species.

4.3.1.1. General recommendations

i) Ensure disturbance is minimised at key areas for birds.

A number of areas on the Humber are subject to anthropogenic disturbance, affecting both feeding and roosting sites. We suggest that appropriate information or restrictions are put in place to minimise disturbance to roosting waders. At low tide the intertidal areas on the outer south shore of the Humber appear to be particularly disturbed by activities such as dog walking. Measures are already in place to attempt to minimise this disturbance, but further publicity of the issue is needed. Additional suggestions arising from the stakeholder consultation include increasing car parking charges in the most sensitive areas.

ii) Maintain targeted disturbance-based studies

Disturbance resulting from all forms of recreation covered in this report may increase over time, so constant monitoring of both types and extent of activity need to be maintained. Wildfowling has been identified as a possible pressure in several areas on the north and south shores. Examination of the responses of birds in these areas in particular merits investigation.

iii) Undertake tracking studies to study habitat use by non-breeding waterbirds

Further knowledge is needed about how birds use the Humber. It is unclear precisely how closely areas that are used for feeding and roosting by different species are linked (a roost mapping report that was 'in prep.' was unavailable for consultation), and pertinently the time budgets associated with these activities. We recommend a research project, using tracking techniques, to improve this knowledge base.

iv) Integration of results from a full benthic survey of the Humber Estuary SPA

The Humber was lacking a published benthic survey while this report was being prepared (an 'in prep' report on a benthic survey undertaken in 2014 was unavailable). The full survey undertaken across the estuary will represent consistent, baseline information that can be used to inform environmental changes going forward into the future. It is recommended that results from the benthic study are integrated into the outputs from this study. A more rigorous analysis of the importance of different pressures and environmental change on population trends could then be undertaken.

v) A review of the implications and efficacies of managed realignment schemes

As summarised in this report, a number of areas of the Humber have been the focus of existing or planned managed realignment, and detailed monitoring of these sites has been carried out post-breaching. A number of other areas of coast in the UK have also been used in the same way. A comprehensive review of how these areas have been used by birds and the importance, or otherwise, of such sites in the regional context would be a useful contribution to this topic. The efficacy of managed realignment schemes may be a pertinent issue with respect to particular species; e.g. Black-tailed Godwits and the proposed Killingholme development.

vi) Breeding bird survey of the Humber Estuary

Nature reserves, such as Blacktoft Sands, Far Ings, Spurn and Saltfleety publish 'annual reports', but there is no systematic coverage of breeding waterbird distribution around the Humber. Although the majority of waterbirds relevant to the classification are wintering birds, given the increasing disturbance and development issues, the responses of species such as Ringed Plover and Redshank should also be considered during the breeding season.

vii) Ensuring WeBS coverage of the Humber Estuary

It is very important the full WeBS Core Count coverage of the Humber Estuary is achieved. Recent gaps in coverage have been filled, but if any gaps in coverage develop again in the future they should be addressed as a priority. Similarly, WeBS Low Tide Counts, which provide key information on foraging distributions, are due to be undertaken in 2017/18 based on the accepted six-yearly cycle. Planning should be initiated as necessary to ensure this coverage is achieved.

viii) Awareness that birds use hinterland

Several species of waterbird which use the Humber Estuary in important numbers also use the hinterland adjacent to the estuary. Hence there is a need for improved awareness that the associated habitats, such as fields and areas directly inland of the seawall, should also be considered in management plans relating to the estuary. These areas can be important both with respect to foraging by species such as Pink-footed Goose, Golden Plover, Lapwing and Curlew, and also provide secure sites for waders to roost at high tide. Studies investigating foraging by waders on hinterland have been carried out in some areas, in particular in south-east Lincolnshire, but were not available for the estuary as a whole.

4.3.1.2. Recommendations relating to specific areas within the estuary

Inner estuary

Relative to other parts of the estuary counted for WeBS, Cook *et al.* (2013) triggered a high number of Alerts for the areas at Winteringham Haven, Blacktoft, Faxfleet to Brough, and Brough to North Ferriby.

It is not possible to pinpoint precise reasons for changes in these areas, although habitat and morphological change is widely considered to be a contributory factor. It is acknowledged by most stakeholders that habitat and morphological change is typically a natural process, and may derive benefits for other habitat specialists.

Development of wind farms is considered to have affected the distribution of Pink-footed Geese, Lapwing and Golden Plover in the fields in this area and adjacent hinterland. There is no evidence that the plovers have redistributed elsewhere within the estuary; they may have been displaced further afield.

Any detrimental effects of disturbance generated by wildfowling activities may be more pertinent in the inner parts of the estuary than elsewhere in the system. Any associated management relating to wildfowling may therefore be most effectively directed in these areas, particularly given the possible dual effect associated with displacement from fields linked to wind farm development (above). If successful, then benefits of reducing disturbance are likely to be high, as the associated areas may become refuges for aggregations of wildfowl and other species.

Mid estuary

Relative to other parts of the estuary counted for WeBS, Cook *et al.* (2013) triggered a high number of Alerts for the areas adjacent to Immingham docks, Hull, Hessle, Paull, North Killingholme and Goxhill.

Reasons for negative waterbird trends in this part of the estuary are considered to primarily be linked to industrial development, and associated loss of habitat and disturbance with respect to both feeding and roosting areas for wildfowl and waders. Inevitably, this area epitomises the challenge of addressing the imbalance between development and ecology. A number of managed realignment programmes are in place or planned; robust monitoring of these sites will be important to assess the effectiveness of this mitigation (and consequences for species such as Black-tailed Godwit) and thereby inform related future initiatives. It is particularly important that a variety of roost sites (in terms of habitat, spatial location and species composition) are maintained.

Possible effects of increased sea angling have also been highlighted; we recommend further investigation as to whether this is posing a genuine pressure of waterbirds in this part of the estuary, in terms of both disturbance and resource conflict.

Outer estuary

Relative to other parts of the estuary counted for WeBS, Cook *et al.* (2013) triggered a high number of Alerts for the north shore at Spurn Head, and the south shore at Cleethorpes to Anthony's Bank, Grainthorpe, Somercotes, Donna Nook and Theddlethorpe to Saltfleetby.

The spread of spartina has been identified as causing a loss of foraging habitat in some areas, but the primary drivers in this part of the estuary are considered to be disturbance and associated displacement of Dark-bellied Brent Geese from favoured areas, and waders using the foreshores including Oystercatcher and Sanderling for which this part of the estuary is the most important. The sources of this pressure are varied, the most pertinent of which being bait digging on mudflats and recreational activities on sandy foreshores. Education and the possibility of limiting access to certain areas at particular times represent the realistic management options. If successful, then benefits of reducing disturbance are likely to be high; as well as providing important habitat for birds, there are opportunities for public education and engagement.

4.3.2 Non-Humber SPA recommendations

Based on the collated outputs of this study, we suggest the following recommendations that would be pertinent to the interpretation of waterbird data on all sites (including Humber Estuary SPA).

i) Species review of the evidence for distribution shifts in waterbirds

An extensive species-by-species review of contemporary evidence for distribution shifts in non-breeding waterbirds would provide important background context for interpreting the possible influence of site-based factors. This report has attempted to address the issue as far as possible, but a single citeable review would be very useful for any further comparable studies.

ii) *WeBS Alerts* for whole assemblage

Currently the triennial *WeBS Alerts* provides information on the short, medium and long-term trends for species that are the important features of SPAs (and individual SSSIs). We propose that inclusion of comparable information for the entire non-breeding waterbird assemblage would provide very useful and applicable background context if attempting to identify the potential importance of site-based factors.

iii) *WeBS Alerts* for other species to provide context

Currently the triennial *WeBS Alerts* provides information on the short, medium and long-term trends for species that are the important features of SPAs (and individual SSSIs). Further to (ii) above, we propose that inclusion of comparable information for all other species (whether a classification feature or not) would provide useful background context if attempting to identify the potential importance of site-based factors.

iv) Improved information on wildfowling

It has not been possible to either assert or discount the possible effects of wildfowling on the distribution or trends of non-breeding waterbirds on the Humber Estuary SPA. Although certain parts of the estuary are more important than others with respect to wildfowling activities, the relevant information has been too patchy and anecdotal to draw robust conclusions in this study. An online resource documenting the number of regulated visits might aid transparency between stakeholder groups on all estuaries such as the Humber.

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APPENDIX 1

Humber Bird Workshop 2
Water's Edge – 25th March 2014

Attendees

Andrew Taylor	North Lincolnshire Council
Claire Horseman	Natural England
Darren Clarke	Humber Nature Partnership
Emma Veryan	Natural England
Graham Catley	Nyctea
Mike Pilsworth	RSPB
Nick Cutts	IECS, University of Hull
Pete Short	RSPB
Richard Barnard	RSPB
Stella Baylis	Natural England
Tania Davey	Humber Nature Partnership
Tim Page	Natural England
Maija Marsh	Natural England

Introduction – Tim Page/Claire Horseman
Tim reminded everyone that the last workshop was held to identify issues which may be impacting on bird populations.

Claire outlined that this workshop would be focused on identifying solutions to the identified issues.

Issues: Habitat and Morphological change, Land use and farming practises, Data and recording (eg. lack of/gaps in specific data),

- In some circumstances, we can't do much about this issue. We should work out what we can do and park issues which we cannot address.
- There is potential that the intertidal area is steepening. This may mean that the same amount of intertidal area is available but it may be less productive.
- The following questions were posed; to what extent are the fluctuations occurring, what is/not natural? How does a change in one part of the estuary impact upon another? – We are going to struggle until we define 'natural'.
- Habitat creation may be producing SAC habitat, not SPA. This then becomes unsustainable and 'gardening' occurs. Ports/EA are not delivering the most ecological function of habitat loss.
- The group suggested habitat creation and management beyond the designated area.
- We don't know how species are moving around the estuary
- We should identify the species which providing improved/new habitat is going to be difficult e.g. those which are heavily reliant upon mud.
- The group discussed that existing created habitat is not recognised when analysing SPA/SAC/SSSI condition e.g. managed realignment sites. Natural England is undergoing a designation review. However, it should be recognised that there needs to be a regular review of Humber designations if new habitat is being created.
- Agri-environment schemes could be used to help create habitat for birds e.g. wet grassland, saline lagoons.
- Need to factor in public access/disturbance when creating new habitat

- Need a strategic linear refuge and disturbance policy for the estuary
- We could engage with farmers to encourage arable rotation schemes
- Could Water Framework act as a driver?
- What monitoring is taking place

Solutions:

Understand what issues we can do something about
Understand bird movements around the estuary – tracking surveys
Habitat enhancement and creation to create a linked network of habitats for birds
Existing drivers and funds e.g. agri-environment, WFD
Strategic estuary wide compensation-mitigation strategy
Understanding of estuary monitoring to create a coordinated approach
Contract work to determine what is natural change on the Humber (PhD/consultants)
Look at what has worked well elsewhere and use this as a guide (ie. Blacktoft Sands, Whitton Sands)

Issue: land use and Farming

- Planning for loss of farming
- Creation of scrapes, in terms of biodiversity enhancement – quick wins
- Consider habitat creation as well as public access
- Arable farming – more information needed on rotation, how is it being managed. Funding mechanism needed which is competitive

Solutions:

Target specific fields used by birds and start work here – keep birds in favoured areas
Talks with Crown Estate are needed regarding controls on landowners/farmers

Issue: Data recording

- Importance on an estuary-wide scale, a coordinated programme is needed.
- More data is needed on the quality of habitats used by birds on the estuary, especially in MR sites – bird numbers is not enough in terms of data
- Breeding bird survey needs updating as only 3 reference sites were used
- LEP – need to capture opportunities that may arise
- WEBS – lack of counters so there are data gaps in certain areas

Solutions:

Look at study ideas – PhD opportunities, look into funding options
Look into applying for money to inform a condition assessment
Coordinate more with other organisations – EA etc..

Issue: accretion

- Lidar can be very useful to assess extent of change Data available freely from EA or Channel Coastal Observatory: http://www.channelcoast.org/
- It is important to understand habitat change in order to manage bird species
- Is it possible for the consultant undertaking the next stage of work to select a few areas around the estuary to understand the extent of habitat change?
- Consider trials in tradition land management and develop a stock of graziers. Where are the key areas to target? Creation of a post - estuary wide grazing manager?
- Consider other estuaries which may be taking this approach

Solutions:

Understand the extent of habitat change. Potentially target certain areas as part of IPENS study
Consider the potential for an estuary wide grazing project. Have an overview of other estuary grazing programmes
Look at lessons learnt from other estuaries eg. Solway, East Anglia

Issue: availability of high tide roosts

- High tide roost report (NE/RSPB) will provide more information.
- Disturbance may be an issues which requires management
- The group agreed that the availability of high tide roosts may be a limiting factor and creation would be of benefit
- A variety of high tide roosts around the estuary is required
- More information on bird energetics in relation to disturbance/roost availability/unavailability would be useful to understand what distance birds can tolerate between roost sites. This would help us determine if we could create fewer larger roost sites.
- There are opportunities to enhance existing roosting sites which currently suffer from disturbance – identify these.
- It is important to identify crucial roosting sites for designation
- It would be useful to have a 'best practice' guide when developing MR sites

Solutions

Understand energetic impacts of travel between roosting sites to determine number and size of sites
Enhance and create new roosting sites, implement management measures
Designate important roosting sites.

Issue: lack of hinterland

- The group agreed that there was a lack of hinterland, especially on the north bank
- Farming practice was discussed as a way to improve hinterland e.g. winter stubble, cropping and growing times, use of machinery
- Land could be managed in different ways for different species
- Work with farming organisations and colleges to promote best practice – land secured better for the future, rather than relying on good farming practices
- Link improved hinterland to planning e.g. wind farm proposals to create wet grassland as mitigation
- National sensitivity maps are needed – windfarms

Solutions

Promote best practice with farming organisations
Humber sensitivity mapping to wind farm development to create a strategic mitigation strategy e.g. wet farmland

Issue: managed realignment

- New managed realignment sites need to consider ongoing management/maintenance regime.
- Need to recognise that there will be some bird species will be difficult to compensate for. However, how does this fit with the legal system?

Issue: Habitat Change

- Control of Buxthorn dune extent: saltmarsh logic could be applied to other parts of the estuary
- Need to consider saltmarsh:mudflat ratio
- MR and habitat creation – life expectancy is short-term which leads to SPA quality issues in the long-term
- Need to assess FRMS success

Solutions

Look at sites that do work – RSPB sites, management plans
Gain more of an understanding of estuarine/natural processes – how the estuary is changing

APPENDIX 2

Birds on the Humber Workshop
Water's Edge - July 15th 2013

Attendees

Andrew Gibson	Yorkshire Wildlife Trust
Andrew Taylor	North Lincolnshire Council
Andy Sharp	Lincs Wildlife Trust/Far Ings NNR
Anna Moody	North Lincolnshire Council
Darren Clarke	Humber INCA
Delphine Suty	Natural England
Denice Coverdale	Natural England
Graham Catley	Nyctea
Mike Pilsworth	RSPB
Nick Cutts	IECS, University of Hull
Pete Short	RSPB
Richard Barnard	RSPB
Stella Baylis	Natural England
Tania Davey	Humber Management Scheme
Tim Page	Natural England

Introduction – Tim Page
The origins of the workshop were born from the SSSI condition assessment undertaken at the end of 2010 which indicated a decline in certain bird species. The aim of the meeting was to identify, discuss and record issues which may relate to declines in bird numbers. For short talks were given:

- **Habitat change on the inner estuary - Nick Cutts, IECS**
- **Recent analysis of WeBS data for NE – Denice Coverdale, NE**
- **The 2010 SSSI birds condition assessment exercise – Tim Page, NE**
- **The EMS Recreational Disturbance Studies – Tania Davey, EMS Management Scheme**

Flipchart content – Darren Clarke

5. INNER ESTUARY (WEST OF THE BRIDGE)

A brainstorming session identified the following main issues as influencing bird populations:

- **Habitat and morphological change**
- **Windfarm development**
- **Land use and farming practice**
- **Wildfowling**
- **Land drainage**
- **Changes in species balances**
- **Climate change**
- **Recreation generally**
- **Feral geese/Non native species**
- **Non-Humber changes**

- **Creation of Alkborough**
- **Low flying aircraft**
- **Data and recording**
- **Low level of industrial development in this part of the estuary**
- **Change in prey availability**
- **MOD**
- **Boat traffic**
- **Bridge**

5.1. Habitat and morphological change:

- May have either a positive or negative impact
- Difficult to decide what is natural change in a dynamic system
- Habitat change provides opportunities for different species e.g. reedbeds – harriers, bearded tit, water rail
- Recognise ecosystem services values
- Natural cycles need to be recognised - can we say what these are with any level of confidence?
- Impact of the Trent training wall on accretion and erosion
- Changes in dredge strategy at Havens and outfalls
- Change in estuary dredging and disposal within the estuary
- Possible influence of erosion of Holderness coast and increased accretion
- Climate change
- Alkborough will continue to change and this will have an impact on how birds use the site.
- Future habitat may not be suitable for current suite of species
- Problems may be exacerbated if habitat is not present / created elsewhere
- Increased saltmarsh may provide increased access to the estuary. It may also provide screening.
- Changes in accessibility – may be positive or negative

5.2. Windfarms:

- Main species affected: pink footed goose, lapwing and golden plover
- Evidence suggests that birds will avoid an area where a windfarm is developed – impacts on the population result from exclusion / avoidance rather than direct collision though this may happen
- Mixed data /evidence as to the actual impact of windfarms on birds
- Difficult to identify where the critical point is re: consenting new developments, ie. when will we reach the red line (cumulative impacts) that should not be crossed
- Importance of night time surveys - data
- Uncertainty around inland / estuary population mix of golden plover – data
- Impact of changes in cropping regime
- Radar surveys – data

5.3. Land use and farming practice:

- Grassland provides additional feeding
- Till affects food and habitat availability / suitability
- Changes in cropping regimes and varieties have an impact – can local agreements be established re: rotation?
- Agri-environment schemes
- Establishment of a grazing project
- High value of land and productivity makes take of agri environment schemes low

- Farms have increased in size leading to increased mechanisation
- Polytunnels – 'Enviromesh' – excludes everything. Apparent take up of this sort of thing in big fields around the M62 bridge may have affected use of the area by plovers.
- Drainage – recent change in pace and investment
- Use of rocket scarers at Saltmarshe

5.4. Wildfowling

- Felt to have a major impact, particularly re: distribution
- Data is often not publicly available but this is potentially a good data source.
- Mobile phones etc. meant quicker communication maybe resulting in increased pressure / effort
- Increase in shooting through the day. Never used to happen. Some concern amongst club members.
- Farmers are renting fields out for wildfowling
- Fewer mallard released on the inner estuary
- Potential to 'police' / warden through clubs but can be difficult where unregulated activity occurs.
- Potential beneficial land management by wildfowlers
- Education packs and litter collections undertaken by wildfowlers
- Some wildfowlers changing to multi-shot guns from double barrel
- No general feeling against wildfowling
- Logging in system at Alkborough – no longer used thus more difficult to get a handle on numbers of visits.

5.5. Changes in species balances

- Predator / prey relationships e.g. foxes, rabbits can affect wader populations. Decline in rabbit populations has coincided in increased ground predation of breeding waders.
- Feral geese destroying reedbed
- Growth in barnacle geese impacting on wigeon
- Effectiveness of anti-predator measures
- Himalayan balsam felt to have an impact on reedbed habitat

5.6. Climate change

- Potentially a big impact, but can we do a lot locally?
- Loss of habitat through coastal squeeze, may also be gains in some areas
- Changes in species distribution – data needed. Are species still coming to the Humber as much? Need to consider changes outside Humber.
- Build in mitigation and adaptation to management plans
- Opportunities to create further new habitat to compensate for losses needs exploring

5.7. Recreation generally

- Difficult to police
- Feeling that recreation can have an impact in this area but potentially not as much as other parts of the estuary
- HMS work important
- Often occasional events rather than regular incidence – in-combination impacts
- Education may be needed
- Apparent increase in use of footpaths in recent years
- Proposed HMS study sites: alternatives to Winteringham e.g. Barton

5.8. Feral geese

- Moulting feral geese can overgraze reedbeds at Blacktoft. Can provide opportunities for avocet nesting.
- Can exclude other species

5.9. Data and recording

- Breeding wader survey needed?

5.10. Creation of Alkborough

- Declines may have happened prior to creation of Alkborough causing a change in distribution
- Generally a positive impact
- May not be a long term answer – management critical
- Is the site properly included in recording?

5.11. Additional issues raised:

- Restriction of access at Chowder Ness
- Read's Island
- Mink predation and increasing otter numbers
- Look and direct intervention of habitats

Misc extra points raised for inner estuary
Nick Cutts said that there had been significant habitat changes as regards the inner estuary. 1988 – 2003 a period of significant change around Whitton Sand and Crabley. Mud taken over by saltmarsh. The overall intertidal may not have changed too much but huge changes in the proportion of mud to vegetated intertidal area. Also an apparent "steepening" of the intertidal. Graham Catley said the Winteringham to South Ferriby frontage had also lost mud.
Relating to the point immediately above; Nick raised the issue of a cyclical change in bird numbers. It may be that the period looked at for the purposes of redesignation (late 90s/early 2000s) was a high point in terms of populations which makes mainteneance of these levels in relation to achieving favourable site condition more problematic.
There are human induced changes which we can't do anything about, for example the training wall at Trent Falls, though clearly we need to be aware of them and their influence.
An additional issue may be the interaction of what we think of as Humber populations with other sites. For example, plover, curlew and wigeon with the Lower Derwent Valley.

2. Middle Estuary (Bridge to Grimsby / Hawkins Point)

A brainstorming session identified the following issues as influencing bird populations:

- **Industrial development (both inside and outside the designated site)**
- **Accretion and growth of vegetation on the intertidal**
- **Sea angling**
- **Motor bikes and dog walking**
- **Humber flood risk management strategy**
- **Availability of high tide roosts**
- **Redevelopment of previously developed land**
- **Changes in discharges (both quality and quantity)**
- **Land drainage and associated dredging**
- **Changes in invertebrate communities**
- **Improved access on areas of the north bank**
- **Humberside airport**

5.12. Industrial development (both inside and outside the designated site)

- South Humber Gateway area (EH Skitter to Grimsby) is a major focal point on the estuary
- Challenge of addressing imbalance of values between development and ecology – legislative vs economic drivers: ecosystem services
- Management of (and access to) mitigation areas important
- High quality habitat needed – is this being created in compensation schemes?
- Like for like habitat and/or function
- Compensation ratios
- Compensation site design. Compensation is generally in the form of managed realignments.
- Development may cause positive or negative morphological changes e.g. accretion at Humber International Terminal
- Data, monitoring and modelling important
- Development inland can affect roost sites
- Small scale developments may have disproportionate effects

5.13. Accretion and growth of vegetation on the intertidal

- Blocks of monoculture - Spartina and couch.
- Height of vegetation
- Some grazing being introduced on north bank
- Grues – East Halton to Goxhill – management agreement re: cutting
- Evidence – Humber Wader Ringing Group – changes in catches for ringing
- WeBS counts
- LIDAR – check if flown at low water?
- NVC (2001)
- CHAMP
- Google Earth?
- Annual aerial photography by Environment Agency - contact EA?

5.14. Sea angling

- Main areas are Pyewipe to Immingham, Goxhill bend and East Halton
- Apparent increase in the last five years
- As with wildfowling, an apparent change in the pattern of this activity, eg. more fishing through the tide and out on the mud rather than just around high tide from the sea wall.

- Could be managed by preventing unauthorised vehicular access to flood defences – increasing problem?
- Where anglers are accessing mudflats this 'removes' an area of mudflat for bird species
- May be more prevalent on the south bank
- Education
- Change of equipment being used

5.15. Motor bikes and dog walking

- Can be a problem on realignment sites
- Motorbikes at East Halton Skitter
- Education
- Enforcement
- Demonstrating disturbance is difficult – third party damage?
- Compartmentalisation of the bank – providing alternative areas
- Public opinion vs alternatives

5.16. Humber flood risk management strategy

- Deficits in habitat balance under CHAMP
- Coastal squeeze compensation. High quality habitat needed – is this being created by managed realignment?
- Potential loss of roosts to realignment may require mitigation

5.17. Availability of high tide roosts

- Felt to be limiting in some cases
- Differing impacts between species depending on whether they remain within the designated site or not. Also varies with tidal cycle as some species may roost within the site on neap tides.
- Availability (or lack) of safe roosts on spring tides thought to be significant.
- Reasons for loss varies – development, succession, agri-environment targeting
- Spread of housing – Eg. in the Grimsby/Healing/Europarc area development seems to have led to more pedestrians and more dog walking. At a similar time there have been declines in Golden Plover and Lapwing on the Pyewipe frontage.
- Importance of network of sites – potential for notification / designation. Currently there may be a slow chipping away at the network of roosting options for birds.
- Environmental stewardship does not currently target Humber designated site features
- Identification and securing management of sites important – RSPB report in production

5.18. Changes in discharges (both quality and quantity)

- Can be locally significant – improvement in water quality. See Grimsby Dock to Cleethorpes
- Data from EA reports
- Pyewipe curlew population changes
- Amalgamation of discharges in some area e.g. Killingholme
- Reduced management of surface water discharges leading to increased siltation.
- Potential effect on some species depending of food material e.g. New Holland to Goxhill, goldeneye numbers ok but pochard are down

5.19. Changes in invertebrate communities

- Water quality effects – e.g. changes in Capitellids
- Data needed – v. important but not well studied
- South bank around main discharges
- What are relationships between changes in discharge and invertebrate distribution?

- WFD vs SPA? Uncertain how this will be balanced
- Increased organic input from reedbed and saltmarsh?

5.20. Improved access on areas of the north bank

- Changes of flood bank cutting regime in some areas leading to increase access
- Dog walking
- Push for the recognition of health benefits of walking
- HMS recreation study important

5.21. Humberside airport

- Unsure whether this is an issue or not.

3. Outer Estuary (East of Grimsby / Hawkins Point)

Main issues identified as influencing bird populations:

- **Habitat change**
- **Bait digging and angling**
- **Disturbance and access**
- **Direct damage to habitat features through harvesting / collection**
- **Photography**
- **Kite surfing expansion**
- **Kayaking and kayak angling**
- **Managed realignment and other habitat creation**
- **Lack of good hinterland habitat**
- **Wind turbines**
- **Tidal generation and solar PV**
- **Management of the sand spit at Spurn**

5.22. Habitat change

- Spartina spread leading to reduction an available feeding areas
- Sand dune accretion affecting breeding habitat. New areas dune are being formed but may be outside of 'protected areas'. Eg. at Tetney dunes have displaced breeding Ringed plover and Little tern. New habitat has appeared but it's at Cleethorpes and heavily disturbed.
- Sea buckthorn spread
- New flood defences creating new areas of habitat e.g North Coates

5.23. Bait digging and angling

- Loss of the road at Spurn may change distribution.
- Impact varies by species and with digging methodology. YWT assessment work underway
- Often unregulated
- Bass fishery growing – probably manageable but disturbance may be significant during matches
- Changes in equipment e.g 'Sea otter' may have an effect

5.24. Direct damage to habitat features through harvesting / collection

- Increased Samphire harvesting may have an impact on twite
- Cockling largely controlled in recent times

5.25. Photography

- Significant impact in some areas e.g. Donna Nook. Increased disturbance levels either side of seal viewing area.
- Increasing visitor pressure through the year may lead to changes in distribution
- Technology and ease of communication may also lead to increased visitor pressure and disturbance
- Education

5.26. Kite surfing, kayaking and kayak angling expansion

- Potential for disturbance to be locally significant
- Pro-active education needed
- Effects of displacement from one area to another need to be considered
- HMS study important

5.27. Managed realignment and other habitat creation

- Generally a positive factor
- May cause changes in distribution
- Skeffling realignment needs to be looked at carefully. Potential to displace birds from an existing area valuable for roosting.

5.28. Lack of good hinterland habitat

- Crown re-letting tenancies in some areas which may lead to change in management / land use

5.29. Wind turbines

- Potential impact on flyways
- Disturbance during infrastructure creation (cable laying etc.) for off-shore windfarms
  Potential for expansion of onshore turbines inc. single turbine applications?

5.30. Tidal generation and solar PV

- Tidal generation has potential to affect hydrodynamics, sediment supply etc.
- Solar farms may look like large areas of water
- Solar panels on grassland

6. CROSS CUTTING ISSUES

6.1. Data and recording

- Potential for increased resolution in WeBS data. Recording is often carried out at sub-sector level but this is lost in the amalgamation by BTO.
- Data gap – where are birds moving to / from including through a tidal period. Radio tracking study? Some data available from colour ringed black-tailed godwits.
- Breeding Bird distribution could be better studied.

Next steps

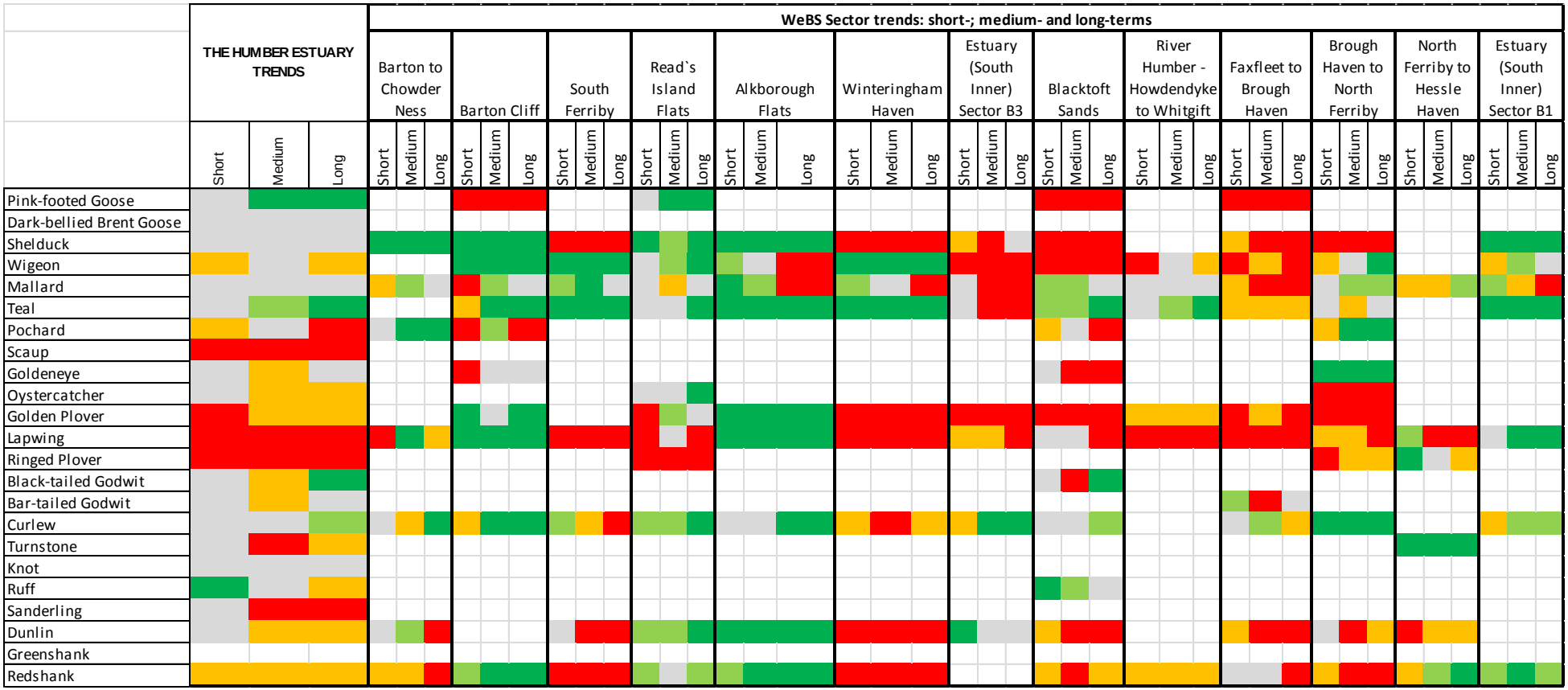
The notes will be circulated to all attended the meeting. Those in attendance are asked to add any further detail and specific locations where issues are occurring. A further workshop will be held in the autumn to consider management solutions.

APPENDIX 3

Sector-level cross-tabulation of updated waterbird trends on the Humber Estuary and potential drivers of change. For convenience of presentation, the information for the table has been split between the four major areas of the estuary – Inner, Middle, Outer North and Outer South. There is a column for an overview of the Humber estuary as a whole and columns for each of the sections (the overview is repeated with each group of sectors as often sector-level detail is not available for other than the bird trends).

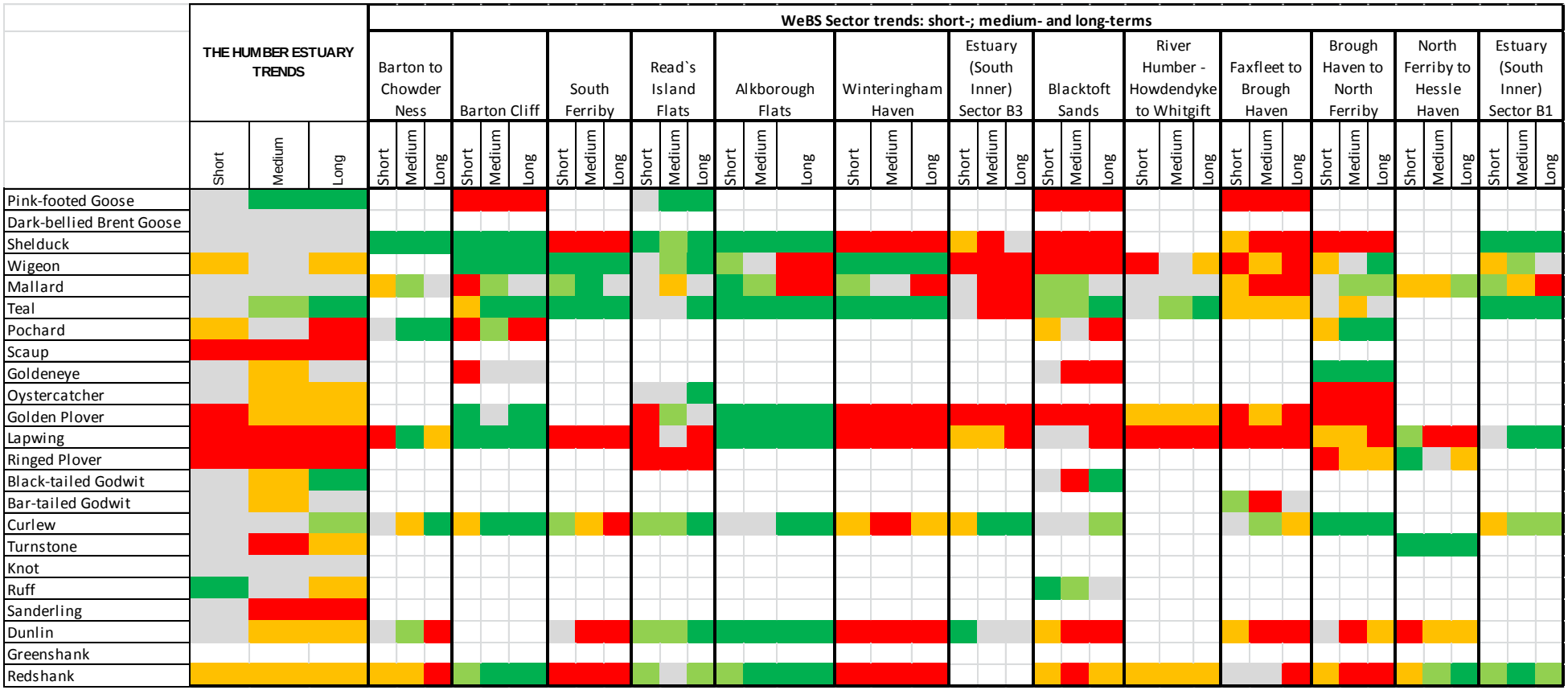
The table is arranged into topic sections covering, for example, Changes to habitat extent; Changes to habitat quality; Food availability/quality/abundance; Disturbance/recreational activities and; other land and water uses. Within each of these main sections, there is a more detailed breakdown of sub-topics. Where page breaks interrupt the flow of the table the header information regarding bird trends is repeated.

For the bird trends over short (5 years), medium (10 years) or long term (25 years), red = >50% decline, orange = 25-49% decline, grey = -24% to +24%, pale green = 25-49% increase, dark green = >50% increase.


THE HUMBER ESTUARY TRENDS
WeBS Sector trends: short-; medium- and long-terms
Barton to Chowder Ness
Barton Cliff
South Ferriby
Read`s Island Flats
Alkborough Flats
Winteringham Haven
Estuary (South Inner) Sector B3
Blacktoft Sands
River Humber - Howdendyke to Whitgift
Faxfleet to Brough Haven
Brough Haven to North Ferriby
North Ferriby to Hessle Haven
Estuary (South Inner) Sector B1
Short
Medium
Long
Pink-footed Goose
Dark-bellied Brent Goose
Shelduck
Wigeon
Mallard
Teal
Pochard
Scaup
Goldeneye
Oystercatcher
Golden Plover
Lapwing
Ringed Plover
Black-tailed Godwit
Bar-tailed Godwit
Curlew
Turnstone
Knot
Ruff
Sanderling
Dunlin
Greenshank
Redshank

Habitat Availability trends															
Tidal mudflats	Historic increases in Inner Humber in medium/long term			Erosion	Erosion		Erosion				Accreting	Historic increases medium/long term			
Saltmarsh						High			High		Rapid growth Brough to Crably 99-03				
Accretion and vegetation growth	Increasing issue in many areas					High					High (Whitton Sand)				
Saline lagoons															
Sand spits/areas above high tide (roost sites)															
Open water (salt water)															
Open Water (freshwater)															
Other…						Reedbed encroachment									
HINTERLANDS															
Regulation															
Intensive agriculture	Signifcant problem around the Estuary														

Table 8 (cont.)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Lapwing
Ringed Plover
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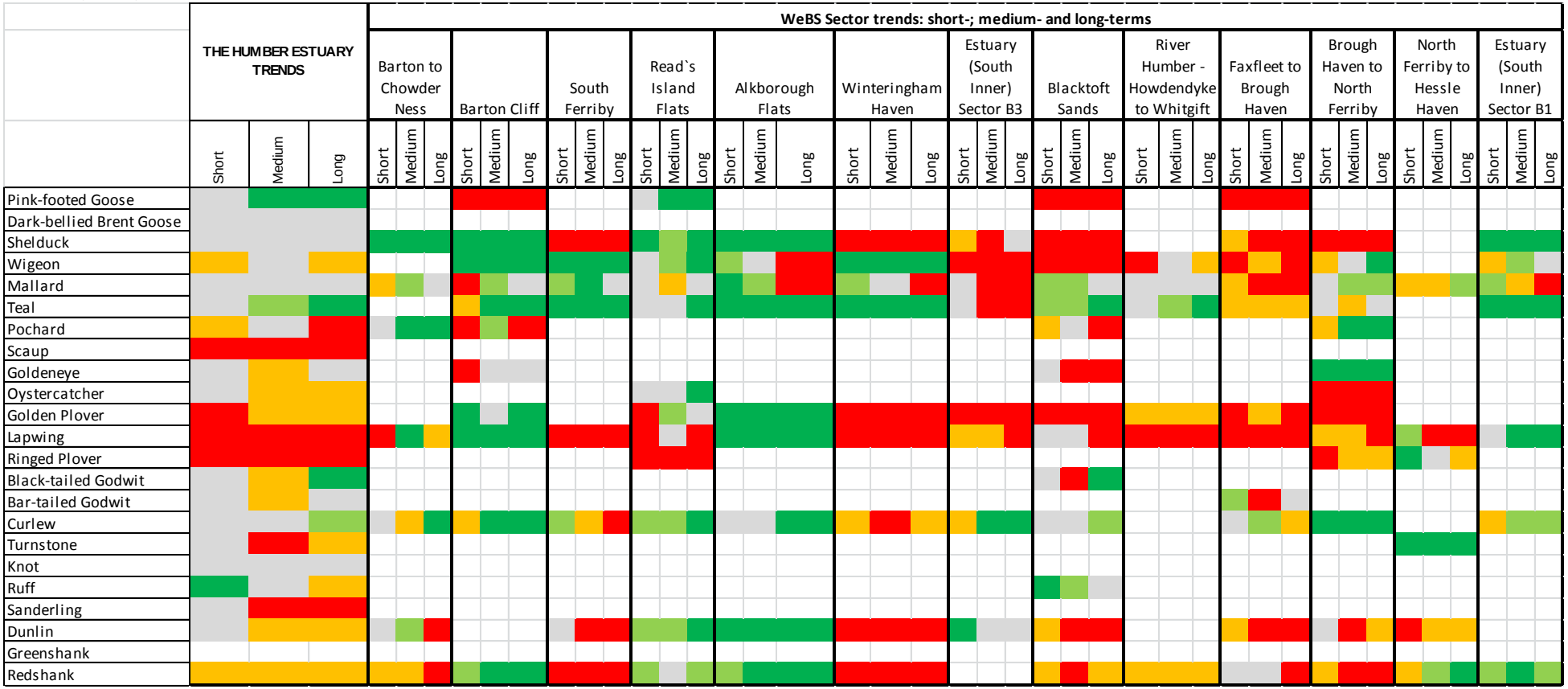
Bar-tailed Godwit
Curlew
Turnstone
Knot
Ruff
Sanderling
Dunlin
Greenshank
Redshank

Food availability/quality/ abundance														
Shellfish (cockles/mussels)														
Other Benthic/tidal invertebrates														
Grass/vegetative														
Roost sites	Birds roosting in	Lack of roost sites												
Other factors														
Recreation (general)														
Walking	Occurs in most/all areas	High				High						High		
Dogs	Occurs in most/all areas	High					High				High	High		
Bird/seal watching	Widespread		V.frequent			High			V.frequent					
Cycling			V.frequent								V.frequent		Frequent	
Motorised recreation			V.frequent											
Horse riding														
Wildfowling					Wildfowling occurs									
Angling	Higher on north bank		Frequent									Frequent	Frequent	
Bait digging														
Samphire collection														
Beach activities														
Water based activities - general					High disturbance									
Sailing	Mainly Inner Humber			Frequent					Frequent		V.frequent			
Windsurfing/Water-skiing/Power boats									Frequent					Frequent
Kitesurfing														
Airborne activities			V.frequent		High disturbance	Regular			V.frequent	Paraglider flies this area	V.frequent			

Table 8 (cont.)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Alkborough Flats
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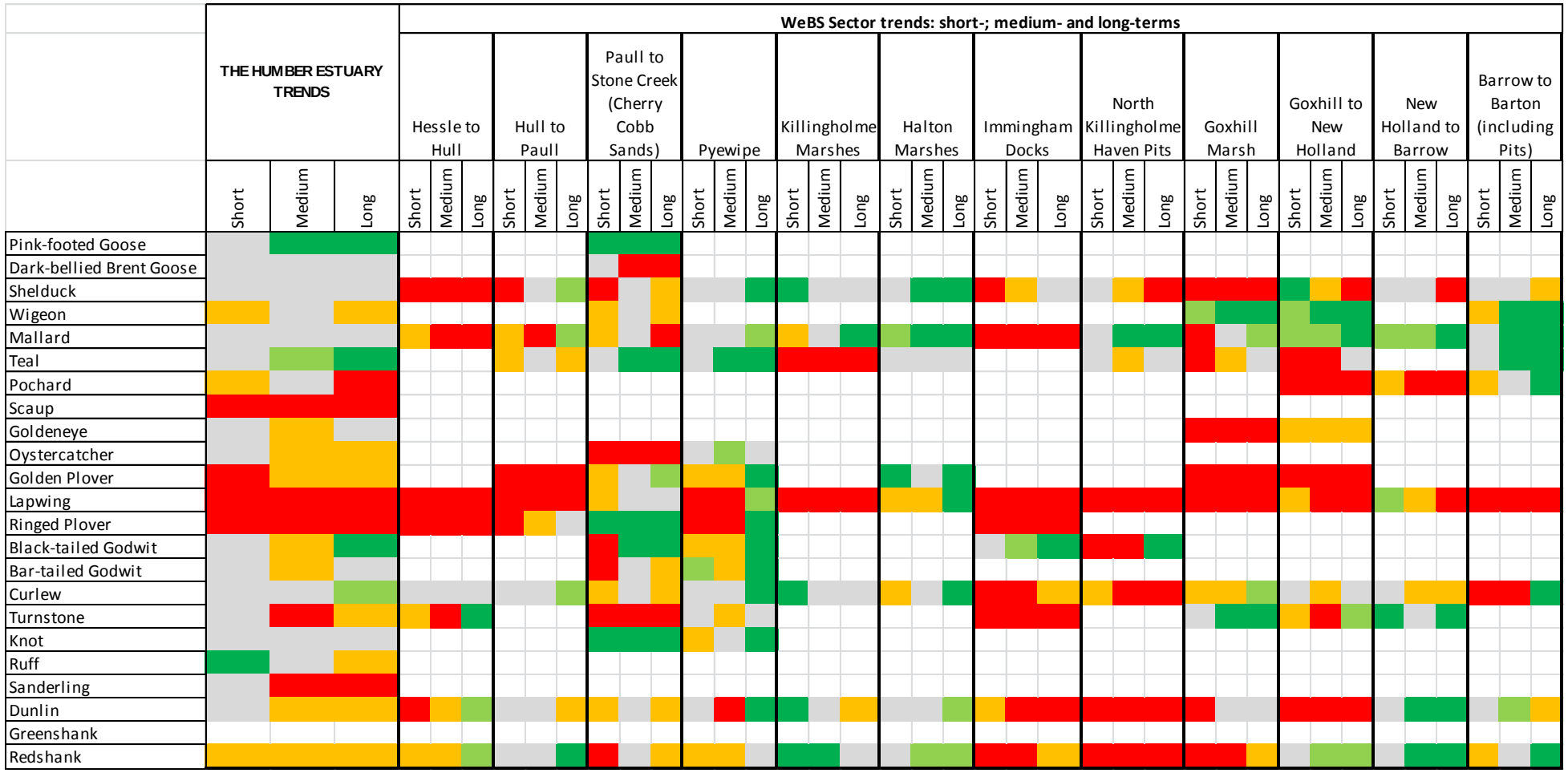
Lapwing
Ringed Plover
Black-tailed Godwit
Bar-tailed Godwit
Curlew
Turnstone
Knot
Ruff
Sanderling
Dunlin
Greenshank
Redshank

Land and water use (excluding recreation)														
Scientific research														
Fishing														
Marine/saltwater aquaculture														
Gathering of shellfish														
Grazing														
Harbour/port activity														
Flood control						Managed retreat area								
Construction														
Renewable energy (offshore)														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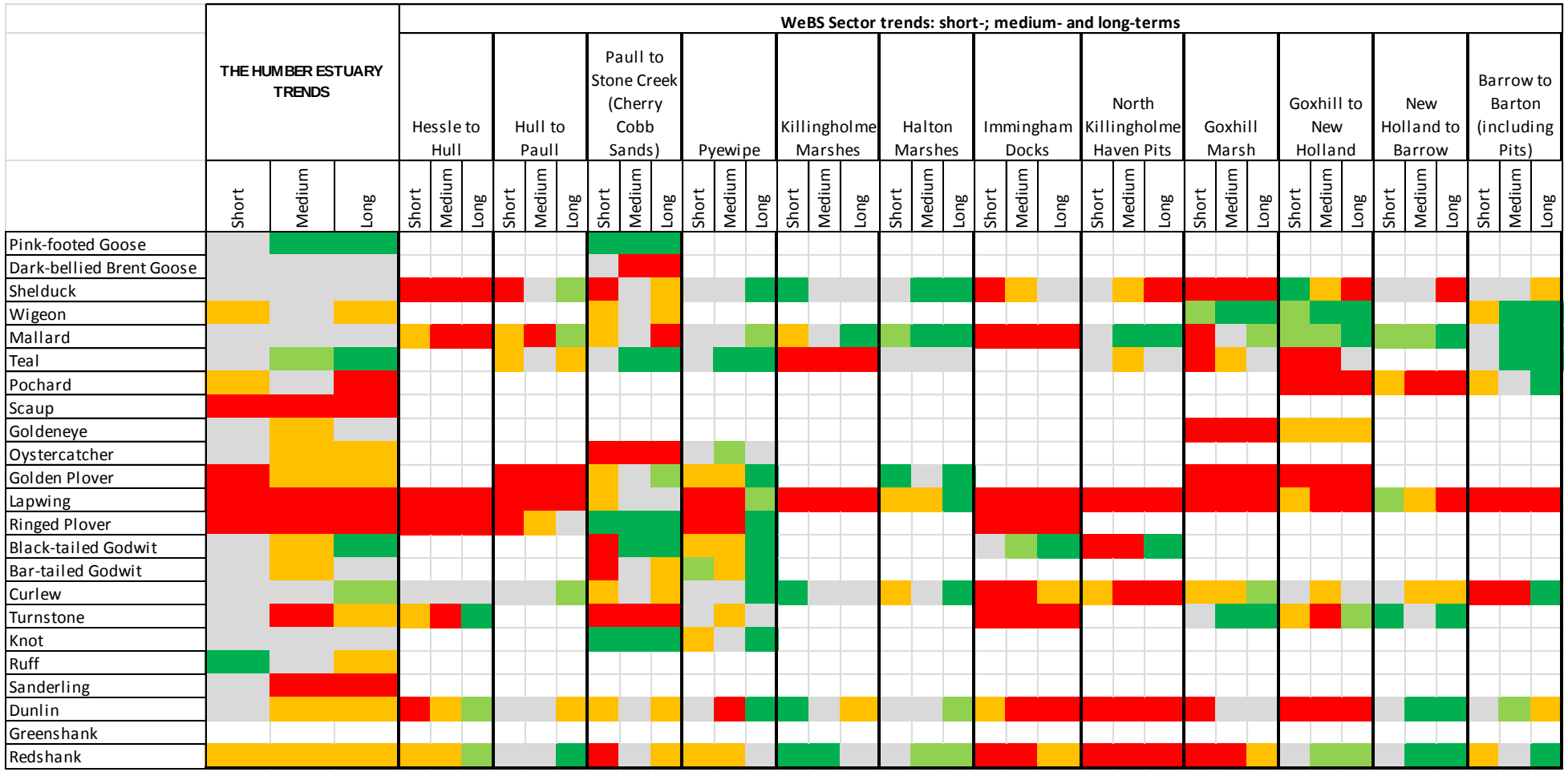
WeBS Sector trends: short-; medium- and long-terms
Hessle to Hull
Hull to Paull
Paull to Stone Creek (Cherry Cobb Sands)
Pyewipe
Killingholme Marshes
Halton Marshes
Immingham Docks
North Killingholme Haven Pits
Goxhill Marsh
Goxhill to New Holland
New Holland to Barrow
Barrow to Barton (including Pits)
Short
Medium
Long
Pink-footed Goose
Dark-bellied Brent Goose
Shelduck
Wigeon
Mallard
Teal
Pochard
Scaup
Goldeneye
Oystercatcher
Golden Plover
Lapwing
Ringed Plover
Black-tailed Godwit
Bar-tailed Godwit
Curlew
Turnstone
Knot
Ruff
Sanderling
Dunlin
Greenshank
Redshank

Table 8 (cont.)

Habitat Availability trends													
Tidal mudflats	Decreases in Middle Humber esp. at Paull but mostly before 1985			New habitat (MRS)									
Saltmarsh				New habitat (MRS)									
Accretion and vegetation growth	Increasing issue in many areas												
Saline lagoons													
Sand spits/areas above high tide (roost sites)													
Open water (salt water)													
Open Water (freshwater)													
Other…													
Hinterlands													
Regulation													
Intensive agriculture	Signifcant problem around the Estuary												

Table 8 (cont.)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Halton Marshes
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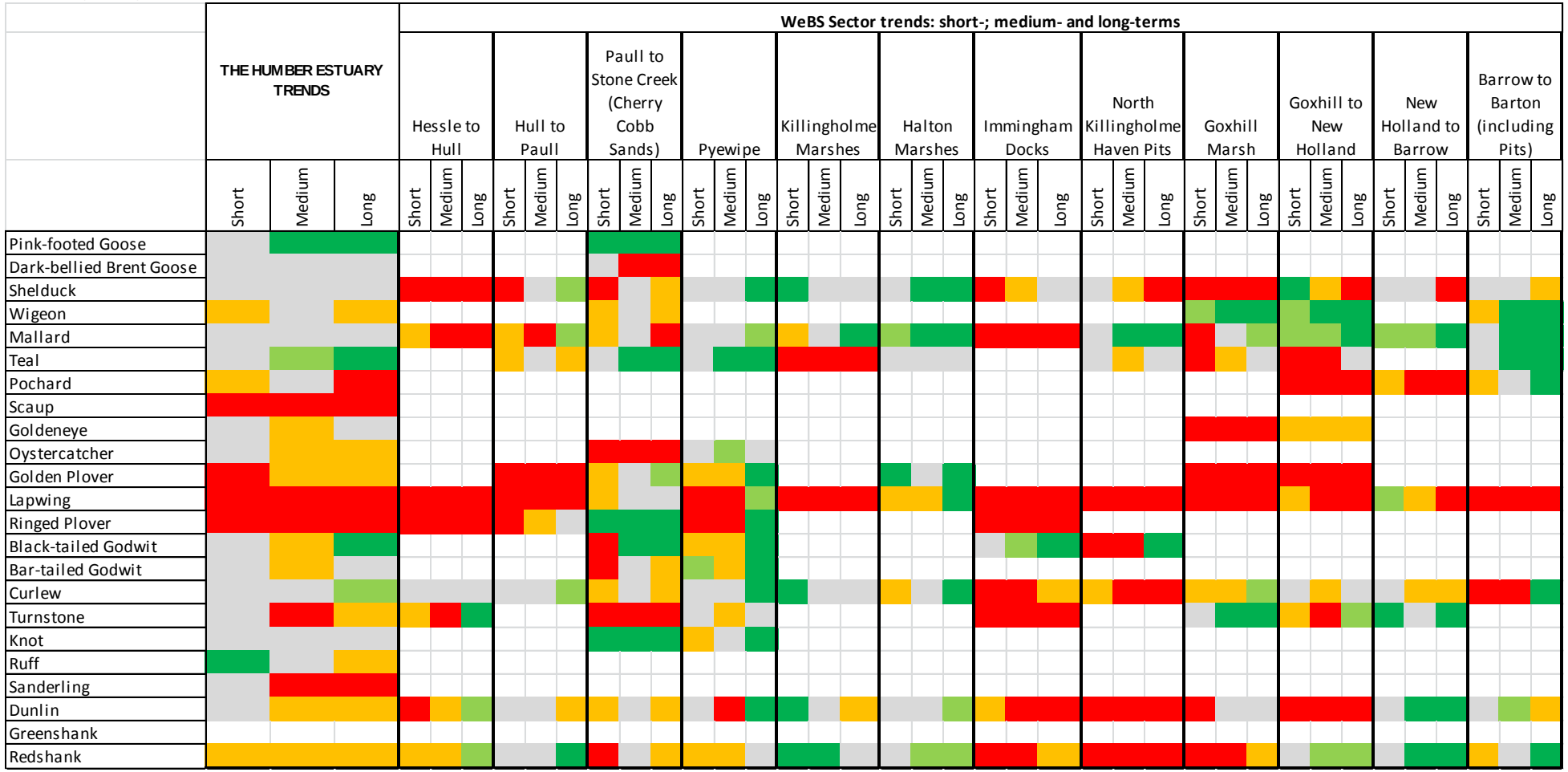
Bar-tailed Godwit
Curlew
Turnstone
Knot
Ruff
Sanderling
Dunlin
Greenshank
Redshank

Habitat Quality trends													
Sewage input	Significant reductions generally, though unclear where strongest effects occurred	Previously high inputs?						Previouly high inputs?					
Food availability/quality/ abundance													
Shellfish (cockles/mussels)													
Other Benthic/tidal invertebrates													
Grass/vegetative													
Roost Sites	Birds roosting in												

Other factors													
Recreation (general)													
Walking	Occurs in most/all areas	High	High							High			
Dogs	Occurs in most/all areas	High											
Bird/seal watching	Widespread										V.frequent		Regular
Cycling					V.frequent			V.frequent					V.frequent
Motorised recreation					Frequent		Frequent				V.frequent		
Horse riding													
Wildfowling													
Angling	Higher on north bank	V.frequent			Frequent			V.frequent					
Bait digging													
Samphire collection													
Beach activities													
Water based activities - general													
Sailing												Frequent	
Windsurfing/Water-skiing/Power boats													
Kitesurfing													
Airborne activities				High disturbance		Regular				Regular	V.frequent	Frequent	

Table 8 (cont.)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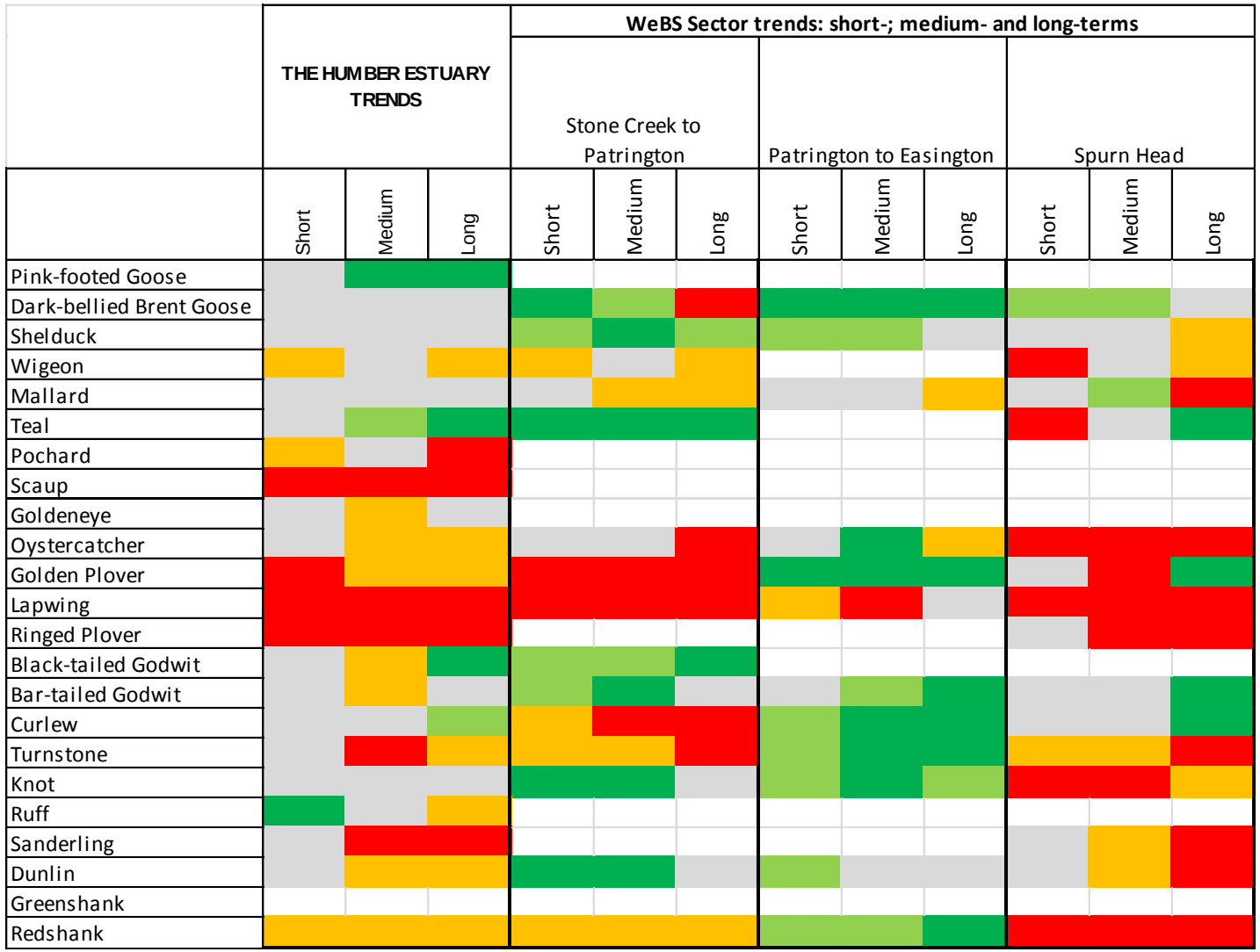
Oystercatcher
Golden Plover
Lapwing
Ringed Plover
Black-tailed Godwit
Bar-tailed Godwit
Curlew
Turnstone
Knot
Ruff
Sanderling
Dunlin
Greenshank
Redshank

Land and water use (excluding recreation)													
Scientific research													
Fishing													
Marine/saltwater aquaculture													
Gathering of shellfish													
Bait collection													
Grazing													
Harbour/port activity			Kingston Docks										
Flood control													
Construction								Deep Water Jetty constrction					
Renewable energy (offshore)													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WeBS Sector trends: short-; medium- and long-terms
Stone Creek to Patrington
Patrington to Easington
Spurn Head
Short
Medium
Long
Pink-footed Goose
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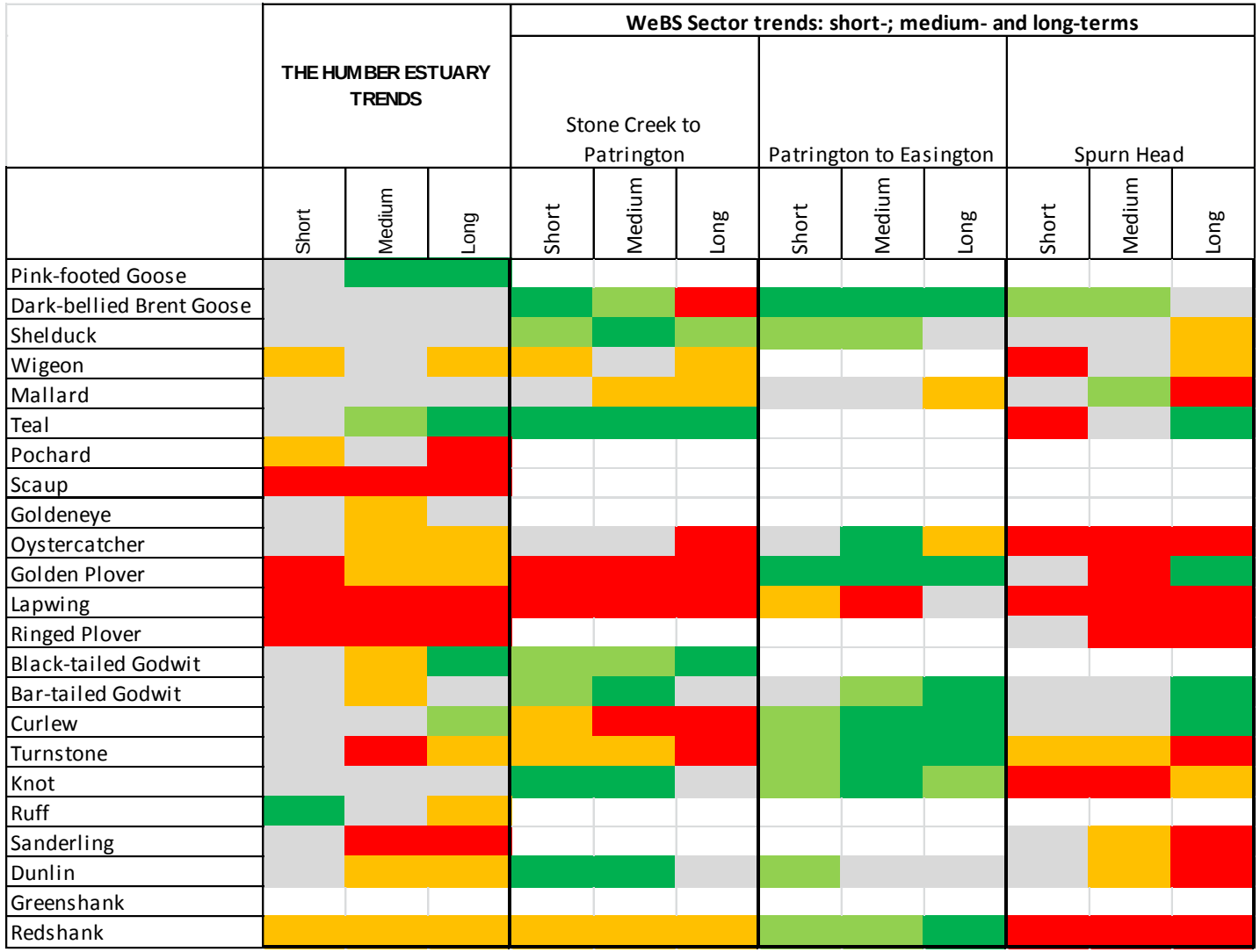
Shelduck
Wigeon
Mallard
Teal
Pochard
Scaup
Goldeneye
Oystercatcher
Golden Plover
Lapwing
Ringed Plover
Black-tailed Godwit
Bar-tailed Godwit
Curlew
Turnstone
Knot
Ruff
Sanderling
Dunlin
Greenshank
Redshank

Habitat Availability trends				
Tidal mudflats	Small increases in Outer Humber in medium/long term			
Saltmarsh		Decreasing?	Decreasing?	
Accretion and vegetation growth	Increasing issue in many areas			
Saline lagoons				
Sand spits/areas above high tide (roost sites)				
Open water (salt water)				
Open Water (freshwater)				
Other…				
HINTERLANDS				
Regulation				
Intensive agriculture	Signifcant problem around the Estuary	Very intensively farmed		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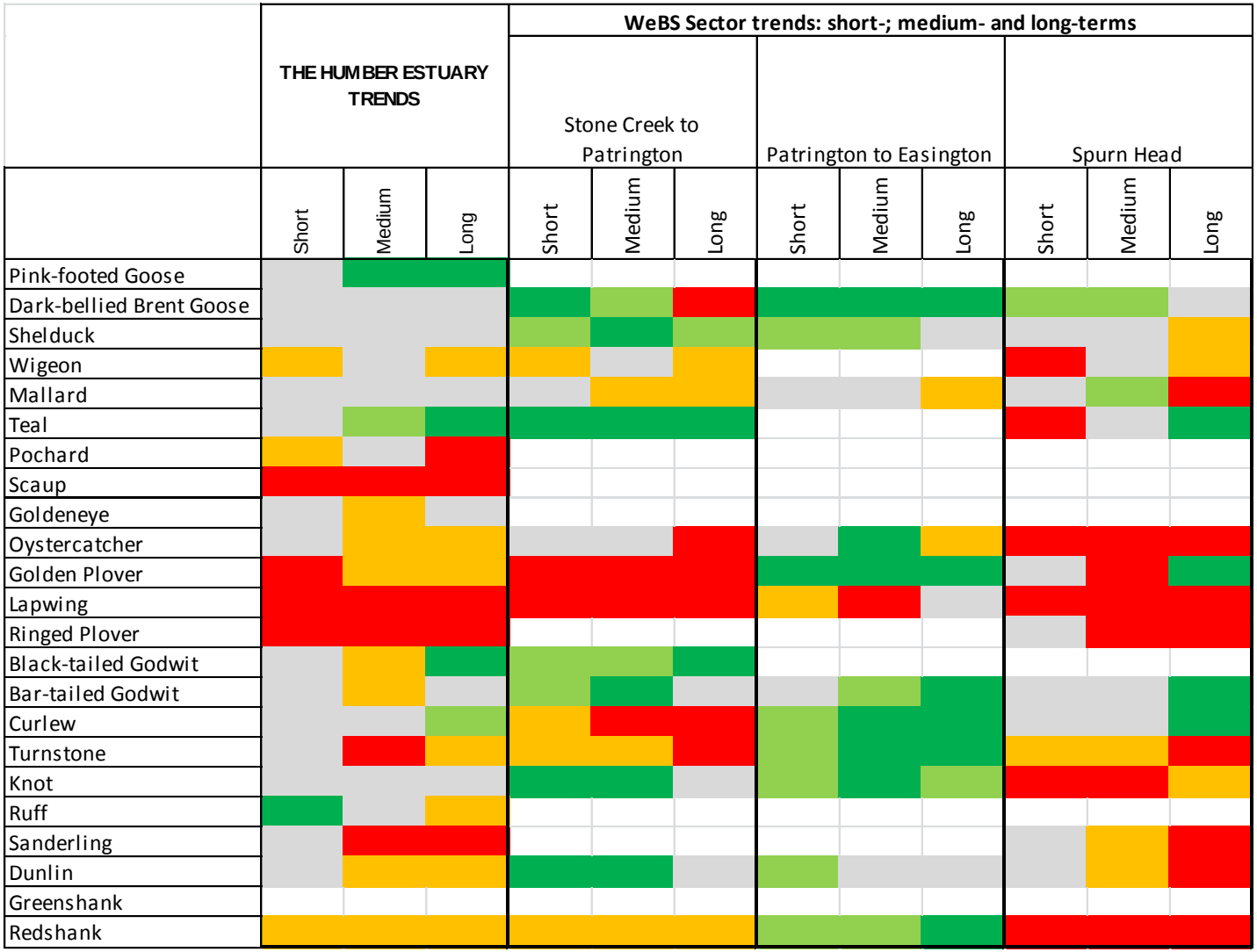
Ringed Plover
Black-tailed Godwit
Bar-tailed Godwit
Curlew
Turnstone
Knot
Ruff
Sanderling
Dunlin
Greenshank
Redshank

Habitat Quality trends				
Sewage input	Significant reductions generally			
Food availability/quality/ abundance				
Shellfish (cockles/mussels)				
Other Benthic/tidal invertebrates				
Grass/vegetative				
ROOST SITES?	Birds roosting in suboptimal habitats			Recent breach has created new less disturbed roost site

Other factors				
Recreation (general)				
Walking	Occurs in most/all areas			High
Dogs	Occurs in most/all areas			
Bird/seal watching	Widespread			Extremely popular area
Cycling				Frequent
Motorised recreation				
Horse riding				
Wildfowling				
Angling	Higher on north bank		V. frequent	V. frequent
Bait digging			Frequent	V. frequent
Samphire collection				Regular
Beach activities				Regular
Water based activities - general				High disturbance
Sailing				
Windsurfing/Water-skiing/Power boats				
Kitesurfing				
Airborne activities				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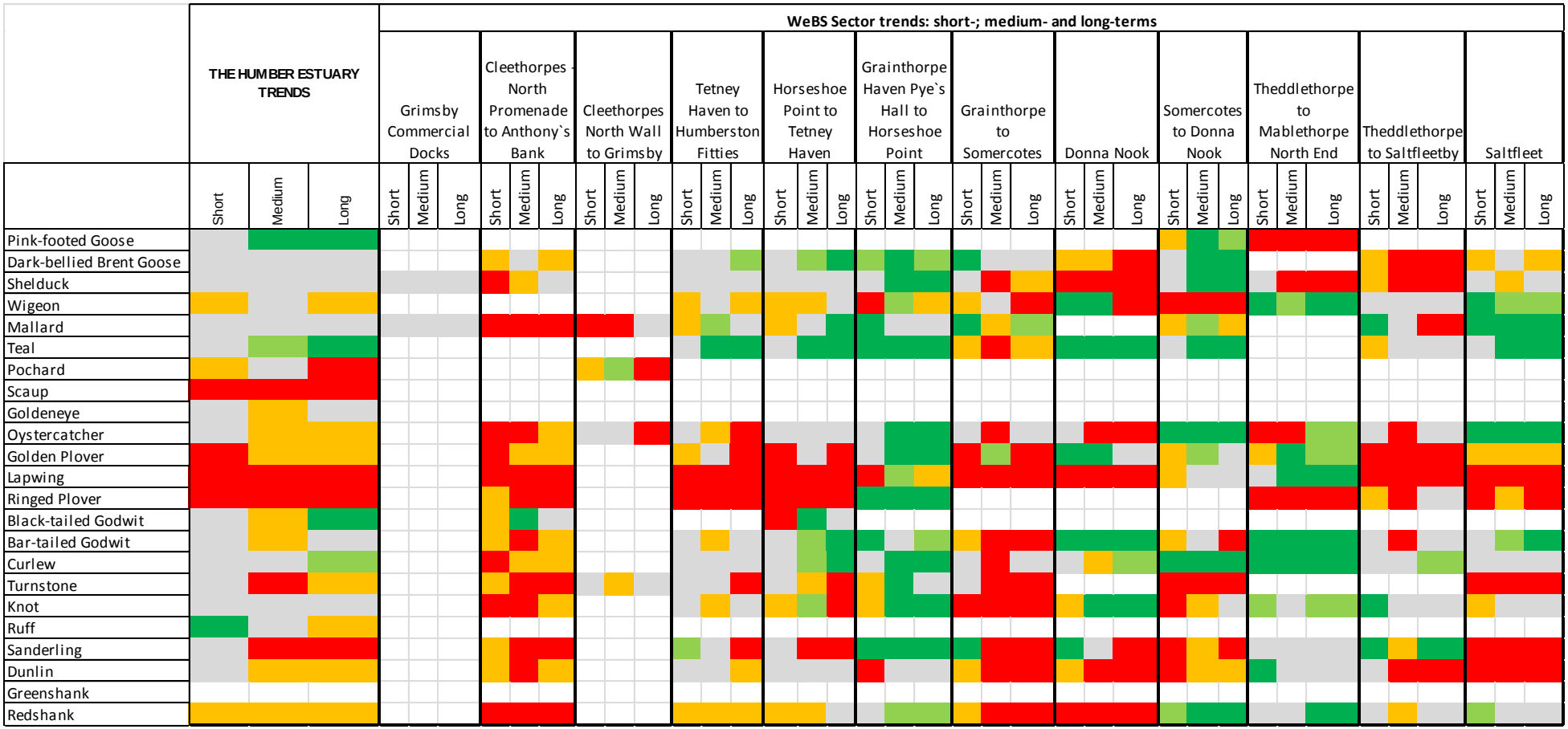
Ringed Plover
Black-tailed Godwit
Bar-tailed Godwit
Curlew
Turnstone
Knot
Ruff
Sanderling
Dunlin
Greenshank
Redshank

Land and water use (excluding recreation)				
Scientific research				
Fishing				
Marine/saltwater aquaculture				
Gathering of shellfish				
Grazing				
Harbour/port activity				
Flood control				
Construction				
Renewable energy (offshore)				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WeBS Sector trends: short-; medium- and long-terms
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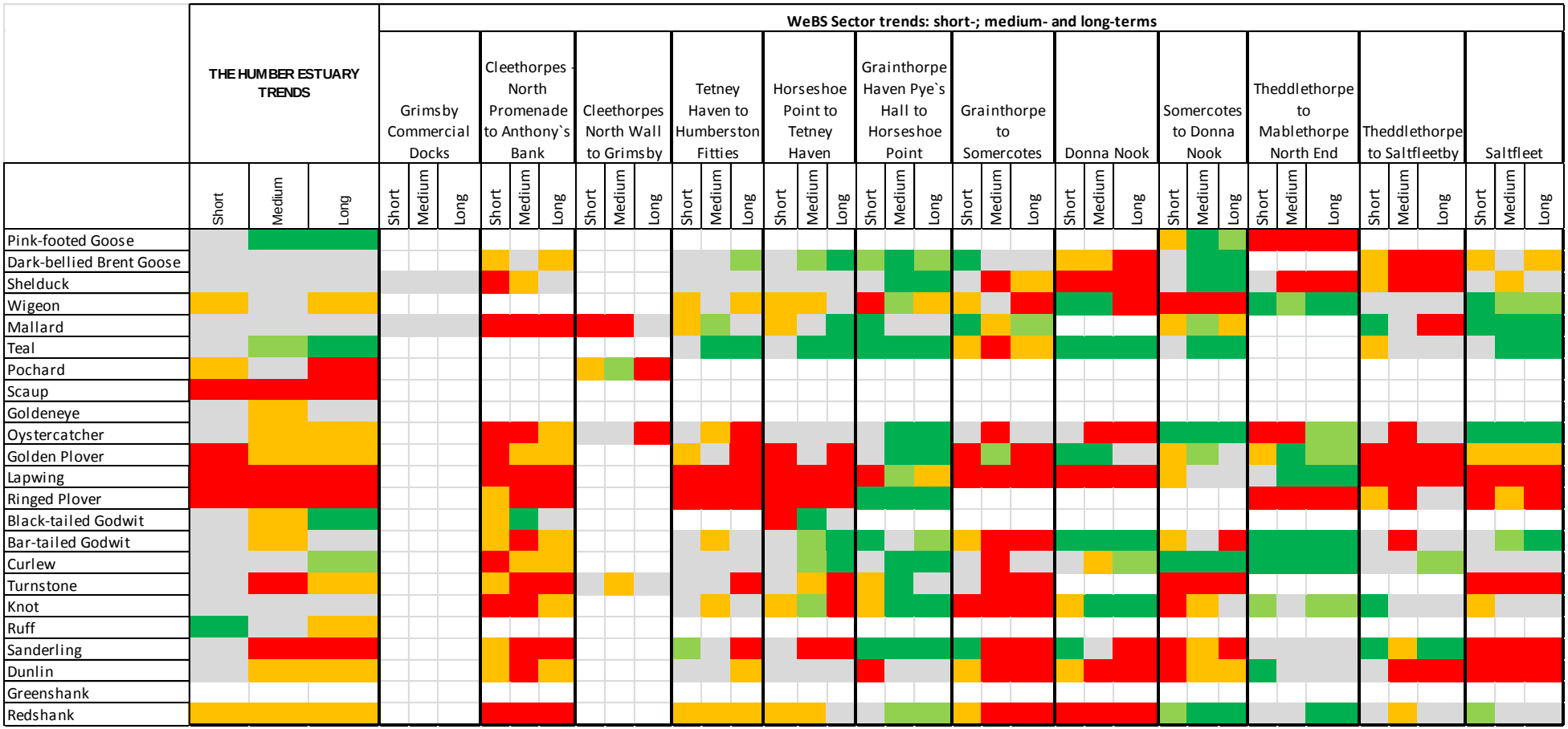
Cleethorpes North Promenade to Anthony`s Bank
Cleethorpes North Wall to Grimsby
Tetney Haven to Humberston Fitties
Horseshoe Point to Tetney Haven
Grainthorpe Haven Pye`s Hall to Horseshoe Point
Grainthorpe to Somercotes
Donna Nook
Somercotes to Donna Nook
Theddlethorpe to Mablethorpe North End
Theddlethorpe to Saltfleetby
Saltfleet
Short
Medium
Long
Pink-footed Goose
Dark-bellied Brent Goose
Shelduck
Wigeon
Mallard
Teal
Pochard
Scaup
Goldeneye
Oystercatcher
Golden Plover
Lapwing
Ringed Plover
Black-tailed Godwit
Bar-tailed Godwit
Curlew
Turnstone
Knot
Ruff
Sanderling
Dunlin
Greenshank
Redshank

Habitat Availability trends													
Tidal mudflats	Small increases in Outer Humber in medium/long term												
Saltmarsh			Increasing?		Increasing	Increasing?				Increasing?			
Accretion and vegetation growth	Increasing issue in many areas												
Saline lagoons													
Sand spits/areas above high tide (roost sites)													
Open water (salt water)													
Open Water (freshwater)													
Other…													
Hinterlands													
Regulation													
Intensive agriculture	Signifcant problem around the Estuary												


THE HUMBER ESTUARY TRENDS
WeBS Sector trends: short-; medium- and long-terms
Grimsby Commercial Docks
Cleethorpes North Promenade to Anthony`s Bank
Cleethorpes North Wall to Grimsby
Tetney Haven to Humberston Fitties
Horseshoe Point to Tetney Haven
Grainthorpe Haven Pye`s Hall to Horseshoe Point
Grainthorpe to Somercotes
Donna Nook
Somercotes to Donna Nook
Theddlethorpe to Mablethorpe North End
Theddlethorpe to Saltfleetby
Saltfleet
Short
Medium
Long
Pink-footed Goose
Dark-bellied Brent Goose
Shelduck
Wigeon
Mallard
Teal
Pochard
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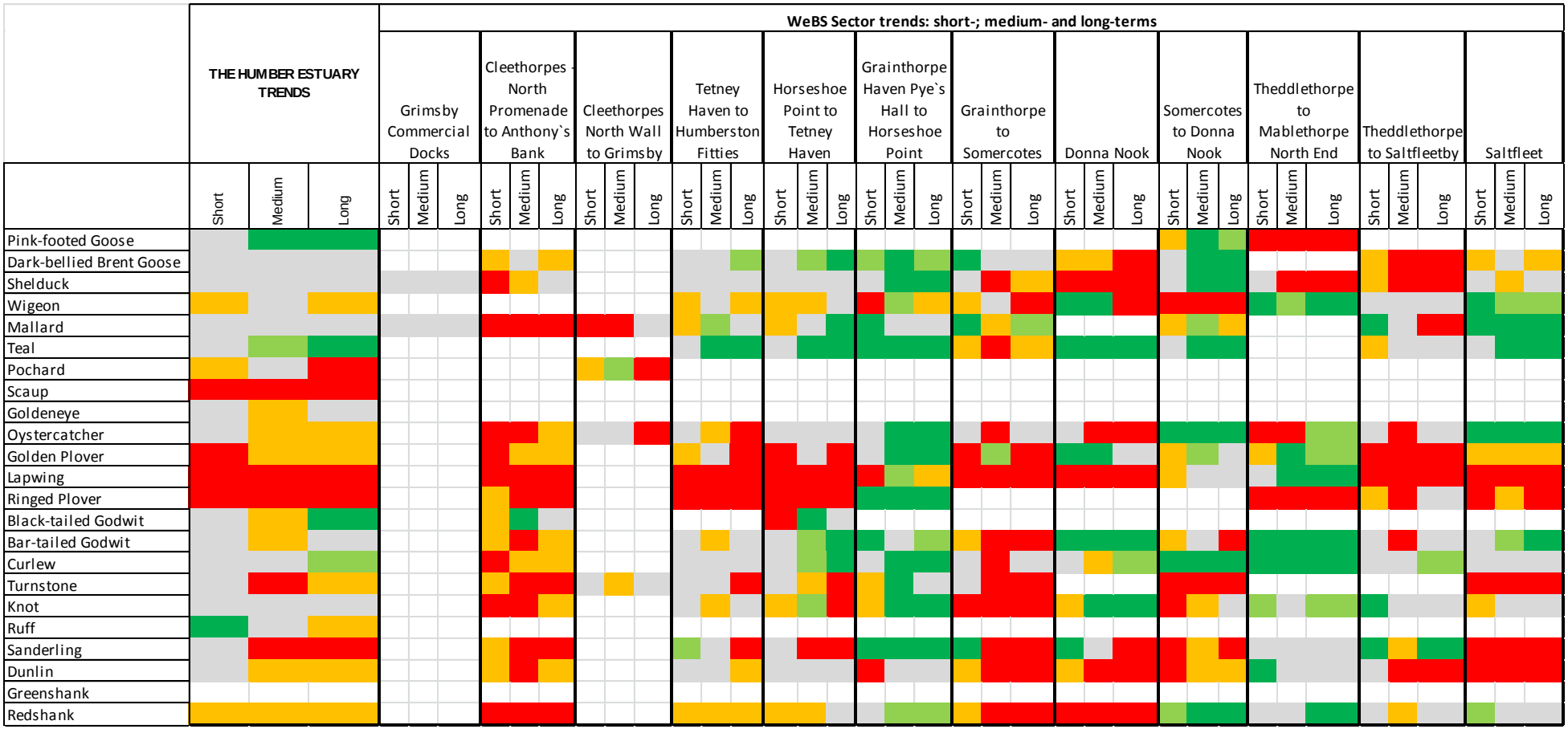
Habitat Quality trends													
Sewage input	Significant reductions generally, though unclear where strongest effects occurred	Previously high inputs?											
Food availability/quality/ abundance													
Shellfish (cockles/mussels)						Cockle Beds currently closed							
Other Benthic/tidal invertebrates													
Grass/vegetative													
Roost Sites	Birds roosting in suboptimal habitats												
Other factors													
Recreation (general)	Very high levels of activity in Outer South area		VERY HIGH						NOW YEAR ROUND				
Walking	Occurs in most/all areas		V. High		High	High			High		High	High	High
Dogs	Occurs in most/all areas		V. High		High	High			High		High	High	High
Bird/seal watching	Widespread								High level of disturbance (seal watching)				
Cycling													
Motorised recreation													
Horse riding			High								V. frequent		
Wildfowling					Occurs			Occurs					Occurs
Angling	Higher on north bank												
Bait digging						Regular	Regular					Regular	
Samphire collection			Regular						Frequent	Regular			
Beach activities			V. frequent		Regular						V. frequent	Regular	V. frequent
Water based activities - general													
Sailing													
Windsurfing/Water-skiing/Power boats													
Kitesurfing			Occurs		Occurs						Major issue		
Airborne activities													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Land and water use (excluding recreation)													
Scientific research													
Fishing													
Marine/saltwater aquaculture													
Gathering of shellfish						Cockle Beds currently closed							
Grazing													
Harbour/port activity		Lack of access for monitoring											
Flood control													
Military Activites									Bombing range				
Construction													
Renewable energy (offshore)													