Development and the North Norfolk Coast
Scoping document on the issues relating to access

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Contents

1. Introduction

This document considers the effects of recreational access on key wildlife species on the North Norfolk coast. In particular it addresses the links between housing development, changes in recreational activity and the internationally important wildlife sites along the coastline. The report is not intended as a comprehensive review of the effects of access, instead it is written with the intention of highlighting issues and informing strategic planning and management decisions on specific sites.

Norfolk's dynamic, north- and east facing coastline is of international importance for its wildlife and also attracts large number of visitors, a mix of local residents, day visitors and staying tourists. The Norfolk Coast AONB runs from Mundesley in the east round to Sandringham and Dersingham, a wide arc encompassing the coast and stretching inland. We focus on the North Norfolk Coast Special Protection Area (SPA) within this report. This SPA lies along the top of the AONB and coincides with the North Norfolk Coast SAC, the Wash and North Norfolk Coast SAC and the North Norfolk Coast Ramsar site. To the west lies the Wash SPA.

There are a complex range of issues regarding housing and tourism policies, and how access can be enhanced and managed to avoid foreseeable impacts upon the area's unique biodiversity. New housing, even located some distance from sensitive wildlife sites, can change the spatial distribution, behaviour and number of people visiting and living in an area. Where these people then go in the countryside relates to the attractiveness of sites, distance, travel time and a range of other factors. The impacts of access, such disturbance to birds, vary according to the type of access, locations and the species involved.

Our approach is therefore to summarise the key species, current understanding of access patterns in the area and the evidence for disturbance and other effects of access. We also highlight areas of concern and make recommendations for additional data acquisition, research and, very broadly, some options for avoidance and mitigation of foreseeable impacts. We highlight the important role of the forward planning (i.e. LDF) process in gathering more evidence, enabling monitoring, and ensuring avoidance and mitigation is secured.

2. Conservation Importance of the North Norfolk Coast and key species

The North Norfolk coastal zone contains a mosaic of different habitats that include marine, intertidal, shingle beaches, sand dunes, reed bed and grazing marsh. There is a string of nature reserves that encompass much of the zone, and the area is of immense importance for wildlife conservation. A detailed account of the conservation importance and the important species of the area is given in Lambley (1997).

Much of the coast lies within the North Norfolk Coast SSSI, and there are a total of 28 individual SSSIs within the AONB. In addition the North Norfolk Coast SSSI is covered by a series of international designations. Details of these designations are summarised here (Table 1) and a full account given in Appendix 1.

Table 1: International designations applying to the North Norfolk Coast

Designation	Geographical Area	Interest Feature
Biosphere Reserve	Blakeney Point, Cley, Salthouse, Holkham, Scolt	
Ramsar	All of N. Norfolk Coast SSSI	Wetlands
North Norfolk SPA	All of N. Norfolk Coast SSSI	Birds
North Norfolk Coast and Gibralter Point SAC	N. Norfolk Coast SSSI above HWM and excluding the grazing marshes	Dune grassland (priority) Lagoons (priority) Mediterranean saltmarsh scrub Shifting dunes Shifting dunes with marram grass Humid dune slacks Coastal shingle vegetation outside the reach of waves
Wash and Norfolk Coast SAC	North Norfolk Coast SSSI below HWM and also adjacent marine area including the Wash	Subtidal sandbanks Glasswort and other annuals colonising mud and sand Altlantic salt meadows Mediterranean salt meadows Mediterranean saltmarsh scrub Intertidal mudflats and sandflats Shallow inlets and bays Common Seal

3. Current understanding on visitor levels and access

It is important to establish the current 'baseline' visitor patterns and profile across the area, both to pinpoint where access at sensitive wildlife areas might currently be of concern, and to enable predictive modeling of future change to inform avoidance and mitigation of any impacts. In the time and with the resources available, it has been possible only to review immediately available data and information. It is likely that more data are available and further work could be undertaken to pull together and review these data.

The North Norfolk coast attracts some 7.7 million day and 5.5 million night visits per year, generating visitor spend of £122 million and supporting 2,325 FTE jobs (Rayment *et al.*, 2000). These estimates were derived from work by the RSPB in 1999 (see Rayment *et al.*, 2000 for full details), which involved interviews with visitors to six locations along the coast, between August and October. A total of 1759 interviews were conducted. Average group size across all sites was 2.3 adults and 0.6 children. Given the survey locations (beach car-parks / visitor centres at Holkham, Snettisham, Titchwell, Cley, Morston Quay and Blakeney) it is not surprising that the majority of visitors had come to view wildlife (33% gave bird watching as the main activity of their visit). Across all sites just 4% of visitors were local residents, 28% were day-trippers from home, 22% were classed as holiday day-trippers and 46% were on holiday and staying in the study area. Taking the 7.7 million estimate of total day visitors, and assuming that the sample of interviews is representative, then the Norfolk Coast perhaps receives in the region of 2.2 million visits that are day trippers traveling from their homes.

The reasons that people visit the area have been identified in a recent survey commissioned by the AONB (Scott Wilson Ltd, 2006), which identified the following reasons that people visit the Norfolk coast:

- Countryside escapism, the coast is perceived to be a particular attraction for people from urban areas (London and the Midlands) looking to escape the pressures and strains of their working life.
- Traditional coastal trips, especially for those who are seeking a more relaxing, secluded and escapist experience compared to visits to resorts and who place a high premium on the quality of the surrounding landscape.
- Wildlife watching, which is identified as a potential growth market due to greater public awareness of the environment and conservation issues.
- Activities orientated, with some adventurous activities such as wind (Kites, Kite Buggying, Kite Surfing) and water sports (canoeing/kayaking, sailing, jet skiing and power-boating) growing in popularity. Visits are less motivated by specific provision for walking and cycling, although walking remains a key activity undertaken once at the destination.
- Cultural and sightseeing, particularly through Sandringham House, Holkham Hall, Felbrigg Hall and the North Norfolk Railway.
- 'Nostalgia' trips, from people re-living their childhood, or re-visiting areas that they may have lived in at previous life stages.
- Food & Drink, with people visiting the Norfolk Coast because it has the potential of offering a strong 'local' context for certain foods and beverages.

There are some details on total visitor numbers for certain sites, which although often estimates give a guide for the scale of visitor numbers to particular attractions. Data for selected sites in Norfolk for 2005 are summarised in Table 2. It can be seen that sites such as Titchwell, a nature reserve and part of the SPA, receive high visitor numbers. This reserve is actually the most visited of all RSPB reserves in the country[1]. It is likely that many other sites may hold data such as car-park totals or ticket returns which would provide useful additional context.

Table 2: Visitor totals to selected North Norfolk sites in 2005. Taken from national tourism agency website[2] (given as source "NTA" in the table) and from Rayment *et al*. (2000). Data for all sites apart from the railway are "estimates". The tourism agency totals are all from 2005. Those in Rayment are older but not for specific years.

Site	Total Visitor Numbers for 2005	Source and year	Notes
Norfolk Lavender	155,000	NTA	3% drop in visitors from 04-05
Sheringham Park	180,000	NTA	No change in visitors from 04-05
North Norfolk Coast Railway	119,485	NTA	1% drop in visitors from 04-05
Titchwell RSPB Reserve	89,210	NTA	11% drop in visitors from 04-05
Cley NWT Reserve	100,000	(Rayment *et al.*, 2000)	30,000 through visitor centre each year
Lady Anne's Drive, Holkham	110,000	(Rayment *et al.*, 2000)	30,000 cars in the busiest 7 months of the year
Blakeney Quay	140,000	(Rayment *et al.*, 2000)	40,000 cars April - November
Morston Quay	140,000	(Rayment *et al.*, 2000)	40,000 cars April - November
Snettisham	41,000	(Rayment *et al.*, 2000)	13,000 cars.

Visitor questionnaire work at the Cley Reserve has been conducted in an attempt to determine the recreational value of the reserve (Klein and Bateman, 1998). Some of the interviews from this piece of work highlight the attractiveness of the coast and the loyalty with which some people visit. One respondent had visited the reserve 500 tines in the past year and another respondent had twice travelled about 700 km for day trips to the reserve. The mean (and standard deviation) distance travelled by respondents to reach the reserve was 96 miles (± 91 miles).

There is also some visitor work that has been done in an ecological context. A novel approach to mapping visitors was conducted by Tratalos *et al.* (2005) who recorded the location of people along the entire East Anglian coastline using a video camera mounted on an aeroplane. Exact totals for different areas of the beach are not given in their report but the work has the potential to provide a useful baseline if the primary data upon which the report is based are available. For three rural areas of coastline in Norfolk, Tratalos *et al.* found distance from car parks to be the primary determinant of visitor numbers to a given 50m section of beach, with distance from entrances less important. Numbers declined dramatically over the first c. 150 m from a car park and this decay with distance was found to follow a similar functional response for all three sites. Statistical analysis of the number of visitors at beach entrances, for almost the entire coastline of Norfolk and Suffolk, showed that the location of entrances to the beach, car

[1] http://naturesvoice.co.uk/reserves/factfile.asp

[2] http://www.tourismtrade.org.uk/Images/Visits%20to%20Visitor%20Attractions%20Survey%20'05%20%20-%20Top%20Attractions%20-%20East%20of%20England_tcm12-28022.pdf

parks, roads, pubs, hotels, caravan sites and public conveniences all influenced the number of visitors at beach entrances and that the number of visitors along any section of coastline could be predicted using as inputs the distance to the nearest entrance and the number of visitors predicted to arrive at that entrance. This research could be used to begin to explore the effects of, for example, car park space management, on access levels and upon sensitive species such as ringed plovers.

As part of doctoral research at Snettisham and Heacham, exploring the impacts of disturbance on Ringed Plovers, the author conducted regular visitor surveys, counting and mapping people along 9km of coast in the mid to late 1990s. These data are summarised in Table 3. The table highlights the range of use and activities taking place. The visitor counts, and car-park data for the same area, at that time, reveal peaks in visitor numbers in July and August, coinciding with the school holidays. There were still people present on the beach from February through until May, with numbers relatively constant over these months (see Liley, 1999).

Table 3: Frequency of different types of potential disturbance recorded on 60 hours of transects, covering the whole study site, between February and August 1996- 1997. "Activities" is an umbrella category for any activity involving people remaining in one spot, such as sun-bathing, picnicking, building sand-castles, bait digging and metal detecting. Table from Liley (1999)

Activity	***Total Count***
Walkers	1393
Birdwatchers	140
Dogs	224
Cyclists	91
Joggers	3
Sailing Boats / Windsurfers	13
Motor Boats / Jet-skis	18
Motor vehicles on beach	112
Horses (& rider)	16
'Activities'	
Sitting or standing still	975
Building work (to holiday homes or sea wall)	14
Metal detecting	3
Picnics	8
Barbeque	16
Beach sports	52
Bait digging	109
Children playing	137
Boat maintenance and launching	71
Beachcombing	10
Fishing	18
Building sand castles	17

Kite flying	7
Botanising	1
Swimming	12
Samphire *Salicornia* sp. picking	3
Total 'Activities'	1453
TOTAL (no of people)	**3212**

These various visitor surveys and estimates of visitor numbers show that the coast is visited by a range of people for a range of different activities. Visitors will include staying tourists, second-home owners, day-trippers from considerable distances and residents in the general area. It is clear that the coast is one of the major attractions.

We have little understanding of how visitor numbers have changed over time, and which groups, if any, have increased. Activities such as kite surfing have clearly increased in recent years, as none were recorded at all during the author's three years doctoral fieldwork at Snettisham and they are now regular there (A. Drewitt *pers. comm.*).

The author is not aware of studies which have addressed specifically where people come from (i.e. home postcodes or addresses) for multiple sites. Data on visitor flows at specific locations may well be available through car-park totals / tickets or similar, but these are often not comparable between sites. For some locations there are specific count data relating to visitor flows (e.g. Snettisham / Heacham area for 1996-99, as documented in Liley, 1999) but these are specific in time and location.

On going work at the Tyndall Centre at UEA is looking at travel distances, travel time and visitor behaviour at Holkam[3], but this is specific again to a single location and is currently unpublished.

There is a very clear need for robust visitor data from across a sample of sites on the coast to understand the links between current visitor rates and the distribution of housing. A review of all available data may enable a robust baseline to be derived. However, we suspect that gaps will be such that further surveys are required to inform visitor management. It is important that the data are collected to a standard method designed specifically to be used in relating visitor patterns to sensitive wildlife. Such survey and modelling methods have been developed for this purpose elsewhere such as the New Forest (Sharp et al., 2008, Tourism South East Research Services and Geoff Broom Associates, 2005), Thames Basin Heaths (Liley et al., 2006a, Liley et al., 2006c) and the Dorset Heaths (Clarke et al., 2008, Clarke et al., 2006, Liley et al., 2006a, Liley et al., 2006b).

Such visitor work should focus on establishing the links between the spatial distribution of housing, the ease of access to different areas of countryside and the numbers of visitors to different sites.

[3] http://www.tyndall.ac.uk/research/phd/coombs.pdf

4. Impacts of access

An understanding of current visitor patterns alone is not sufficient to guide forward-planners and site managers as to whether wildlife is being, or might in future be affected. Relating access patterns to nature conservation impacts is necessary to determine whether there will are or will be adverse affects to European sites, whether mitigation will be successful and where mitigation might be required.

In their review of the impacts of recreation to European marine sites, Saunders *et al.* (2000) split effects into those relating to water-borne activities and those relating to land based recreation. They identify the following impacts:

Water born activities

- engine emissions
- sound emissions
- antifouling paint leaching
- sewage and other waste discharges
- disturbance to wildlife
- erosion and turbidity

Land based recreation

- soil compaction and erosion
- littering and marine pollution
- disturbance to wildlife
- fire

To this list we can add the additional resources (staff time, visitor infrastructure etc) that might be associated with increased visitor pressure or managing visitors. There is not the scope within this document to review all these impacts. The scale of their effect will relate to the types of access, intensity and timing as well as the locations and types of habitat involved. There may also be cumulative impacts.

Of particular relevance to the North Norfolk coast, disturbance and erosion are perhaps of particular concern. We focus on these issues, making particular reference to key species along the coast (such as Ringed Plovers, Little Terns, Geese and Seals) and work conducted in North Norfolk. We have selected these species as they are important species associated with the North Norfolk coast, many are designated interest features and they are also species often considered vulnerable to disturbance. For more detailed reviews of the implications of coastal access, impacts of access and management measures we refer the reader to other sources (e.g. Kirby et al., 2004, McKenna et al., 2000, Penny Anderson Associates, 2001, Penny Anderson Associates, 2006, Saunders et al., 2000, Scottish Natural Heritage, 2007, Taylor et al., 2006).

4.1 Disturbance

4.1.1 Overview

Human disturbance of birds and other wildlife has become a key issue for both conservationists and researchers in recent years. Disturbance can be defined as any human activity that influences a bird's behaviour or survival. There are a wide variety of studies which describe disturbance effects (for reviews see Hill et al., 1997 , Nisbet, 2000, Woodfield and Langston, 2004a). The range of studies is potentially bewildering, demonstrating a range of different impacts, in different circumstances, to different species. There is still contention about the applicability of the methods of study and the impacts on bird populations (Gill, 2007).

Most studies of disturbance demonstrate behavioural effects, such as birds changing their feeding behaviour (e.g. Burger, 1991, Fitzpatrick and Bouchez, 1998, Thomas et al., 2003, Verhulst et al., 2001) or taking flight (e.g. Burger, 1998, Stalmaster and Kaiser, 1997, Blumstein et al., 2003 , Fernandez-Juricic et al., 2001, Fernandez-Juricic et al., 2005, Webb and Blumstein, 2005, Blumstein, 2003). Other studies have focused on physiological impacts, such as demonstrating changes in the levels of stress hormones (Remage-Healey and Romero, 2000, Tempel and Gutierrez, 2003, Walker et al.) or monitoring changes in heart rate (Nimon et al., 1996, Weimerskirch et al., 2002). While behavioural and physiological studies show an impact of disturbance, it is usually difficult to understand whether the disturbance does actually have an impact on the population size of the species in question. For example, the fact that a bird takes flight when a person approaches is to be expected and a short flight in unlikely to have a major impact on the individual in question, let alone the population as a whole.

Certain impacts of disturbance are perhaps more likely to have a population impact. Direct mortality resulting from disturbance has been shown in a few circumstances (Yasue and Dearden, 2006, Liley, 1999) and many (but not all) studies have shown a reduction in breeding success where disturbance is greater (e.g. Arroyo and Razin, 2006, Ruhlen et al., 2003, Bolduc and Guillemette, 2003, Murison, 2002). There are also many examples of otherwise suitable habitat being unused as a result of disturbance (Gill, 1996, Kaiser et al., 2006, Liley et al., 2006a, Liley and Sutherland, 2007). Very few studies have actually placed disturbance impacts in a population context, showing the actual impact of disturbance on population size (Liley and Sutherland, 2007, Mallord et al., 2007, Stillman et al., 2007, West et al., 2002).

It is difficult to rank different recreational activities according to their relative impacts (but see Liddle, 1997), as the location, weather, time of year etc will also be important. A few studies have attempted to focused on particular activities and have shown disturbance effects from aircraft (see Drewitt, 1999), traffic (see Reijnen et al., 1997 for a review) and chainsaws (Tempel and Gutierrez, 2003, Delaney et al., 1999). Some types of disturbance are clearly likely to invoke different responses. In very general terms, both distance from the source of disturbance and the scale of the disturbance (noise level, group size) will both influence the response (Beale and Monaghan, 2004b, Delaney et al., 1999). Studies that have compared different types of disturbance usually show a weaker behavioural response to vehicles than people on foot (Pease et al., 2005, Rees et al., 2005) and to people without dogs rather than people with dogs (Lord et al., 2001). Dogs off leads can have particular impacts, such as flushing adults from the nest thereby leaving the nest vulnerable to predation (Langston et al., 2007, Woodfield and Langston, 2004b).

Many authors define a definitive distance beyond which disturbance is assumed to have no effect and this is then used to determine set-back distances or similar (Rodgers and Smith, 1995, Rodgers and Smith, 1997, Stalmaster and Kaiser, 1997, Fernandez-Juricic et al., 2001, Fernandez-Juricic et al., 2005, Fernandez-Juricic et al., 2004). It is inappropriate to set such distances as responses to disturbance vary between species (Blumstein et al., 2005) and between individuals of the same species (Beale and Monaghan, 2004a). Particular circumstances, such as habitat, flock size, cold weather or variations in food availability will also influence birds' abilities to respond to disturbance and hence the scale of the impact (Rees et al., 2005, Stillman et al., 2001). Birds can also modify their behaviour to compensate for disturbance, for example by feeding for longer time periods (Urfi et al., 1996). Birds can become habituated (Walker et al.,

2006, Nisbet, 2000, Baudains and Lloyd, 2007) to particular disturbance events or types of disturbance, and this habituation can develop over short time periods (e.g. Rees et al., 2005). The frequency of the disturbance event will determine the extent to which birds can become habituated, and therefore the distance at which they respond.

4.2 Ringed Plovers

Ringed Plovers are one of the few species where the disturbance impacts have been the subject of detailed study and the consequences of disturbance for the population size of Ringed Plovers has been determined (Liley, 1999, Liley and Sutherland, 2007). This work was conducted in Norfolk, focusing on the length of coast between Wolferton Creek and the south edge of Hunstanton. The spatial distribution of people varied along this length of coastline, with particularly high levels located near car parks. Ringed Plover territories were located away from areas with high disturbance. The birds arrived on the site in February (a time of year when disturbance levels were low) and early season settlement patterns were such that adults that had bred on the site before settled in the areas with the lowest disturbance levels. The only birds to defend territories near car parks or busy areas of beach were birds that had not bred in the area before. The first nests appeared in April, and there was a significant negative correlation between disturbance levels and the number of nests found for a given section of beach. Birds were more likely to return to undisturbed sites in the subsequent breeding season but moved from more disturbed sections.

Despite this avoidance of highly disturbed areas, 8.5% of nests were still lost through human activity, through accidental trampling. In the presence of humans, chicks fed less and spent less time feeding on the mudflats but no significant effects on chick growth could be detected. Population models incorporating adult survival, breeding success and habitat quality were used to make predictions of the population size the area would support under different scenarios that included changes in the number of people visiting the area. If nest loss from human activity was prevented, for example by fencing nests, then population size was predicted to increase by 8 %. A complete absence of human disturbance was predicted to cause a population increase of 85 %.

4.3 Little Terns

There are few direct studies of Little Terns and the impacts of disturbance. In North America the Least Tern –a near identical species – has been shown to avoid nesting in areas with high disturbance but otherwise suitable habitat (Gochfeld, 1983). In Portugal Little Terns have shifted away from nesting on sandy beaches and instead they are using man-made Salinas. This shift is thought the be linked to human disturbance and habitat loss (Catry *et al.*, 2004).

In Portugal low breeding success of Little Terns has shown to be associated with human activities (Calado, 1996). Detailed nest monitoring has evaluated the influence of human disturbance on breeding success of little terns and the interaction with the seasonal variation in the birds' breeding biology (Medeirosa *et al.*, 2007). The percentage of nests producing hatched chicks varied between 26.7% and 66.4% in different years and habitats. The main causes of hatching failure varied between years and habitats, but predation, flooding and human activities were very common. The presence/absence of protective measures (warning signs and wardening) was the most important predictor of nesting success, with birds being up to 34 times

more likely to succeed with protective measures. Nests were also more likely to succeed earlier in the season.

4.4 Geese

There have been a wide range of different studies addressing the impacts of disturbance to geese (e.g. Percival et al., 1997, Keller, 1990, Madsen, 1985, Stock and Hofeditz, 1997, Riddington, 1996, Gill, 1996, Owens, 1977). These address a range of species, types of disturbance and show a range of impacts. Much work has been undertaken within the Norfolk Coast SPA. Riddington *et al.* (1996) studied disturbance factors that caused Brent Geese along a stretch of the north Norfolk coast to take flight. The most frequent source of disturbance was pedestrians. Those disturbances resulting in greatest energy expenditure were also of human origin, but tended to be 'mechanised' (e.g. aircraft, gunfire). The authors suggested that disturbance may be one of the primary factors influencing local distribution of Brent Geese. Gill (1996) studied the Pink-footed Geese roosting at Scolt Head Island. For most of the winter the geese fed predominantly upon the harvested remains of sugar beet. Beet fields closest to the roost site were used first and the geese fed further from the roost as the beet remains in these fields was depleted. Small fields were avoided by the geese and fields closer to roads were used significantly less.

4.5 Seals

There is a body of literature addressing impacts of disturbance to seals, but this is largely focused on seals in the southern Hemisphere. While some studies have shown no impacts of disturbance (McMahon et al., 2005, Engelhard et al., 2002a, Engelhard et al., 2002b), others have shown behavioural responses, such as aggressive behaviour (Cassini et al., 2004, Cassini, 2001); avoidance of areas with high visitor numbers (Stevens and Boness, 2003) and lower body mass of weaned pups in areas of high disturbance (Engelhard *et al.*, 2001).

Within the UK, work on Mousa (Brown and Prior, 1998) concluded that the most significant source of human disturbance to breeding sites on the SAC was from recreational activities. A research study looking at the effects of human disturbance on the maternal behaviour of grey seals at Donna Nook in Lincolnshire (Lidgard 1996, quoted in Saunders *et al.*, 2000) showed that females preferred to give birth in areas of low disturbance and that pups born in such areas gained weight more quickly than pups born in areas of greater disturbance levels. However, the study was unable to conclude that these differences in weight gain were as a direct result of human impacts.

Boat trips to view seals run out of Morston, near Blakeney. Seals are quite elusive in the water and so are most commonly visible whilst ashore. Here they can be very susceptible to disturbance, particularly while resting, breeding and rearing young (Saunders *et al.*, 2000). Seal watching activities can contribute to disturbance on land, especially as people can have direct and often unrestricted access to them while they are out of the water.

Harbour seals are particularly vulnerable to recreation as their breeding and moulting season lasts from June to August coinciding with the 'peak' tourist and recreational season. The study by Brown and Prior (1998) found that recreational participants who carried cameras or camcorders approached the seals much more closely than those without, and that the closer

approaches resulted in greater levels of disturbance. This study also showed that not all people visiting the site caused disturbance. Almost 40% of the visitors observed caused no disturbance at all. However, 40% did cause serious disturbance resulting in the seals abandoning the haul out site for a period of time. More recent work in Norfolk has highlighted the increase in numbers of grey seals along the East Anglian coastline and the scarcity of harbour seals (Skeate *et al.*, 2008). The authors suggest that disease has precipitated a decline from which harbour seals seem unable to recover; harbour seals now seem unable to breed on the mainland, "presumably because of the pressure of humans and their dogs".

4.6 Coastal Habitats

Trampling can result in soil compaction and a change in vegetation, demonstrated for a range of habitats and circumstances (Toullec et al., 1999, Gallet and Rose, 2001, Kuss, 1983, Cole, 1993, Liddle, 1997). A detailed review of trampling to coastal habitats is provided by Penny Anderson Associates (2001). This guidance highlights that a network of paths can form in dune systems, resulting in a high density of paths. Moderate to high trampling in sand dune habitats can result in an increase in bare ground, increased soil compaction and a reduction in sward height, species diversity and both flower and seed production. There is relatively little work on trampling to shingle systems, but existing work does show that shingle vegetation is easily damaged and plant diversity is reduced by trampling (again reviewed Penny Anderson Associates, 2001).

There is also evidence that saltmarsh and intertidal vegetation is vulnerable. At Lindisfarne (Chandrasekara 1986, in Penny Anderson Associates, 2001) found evidence that trampling caused changes to the infaunal community. He also indicates that the vegetated saltmarsh has developed a permanently distinguishable path along the route and that the vegetation composition may have been altered.

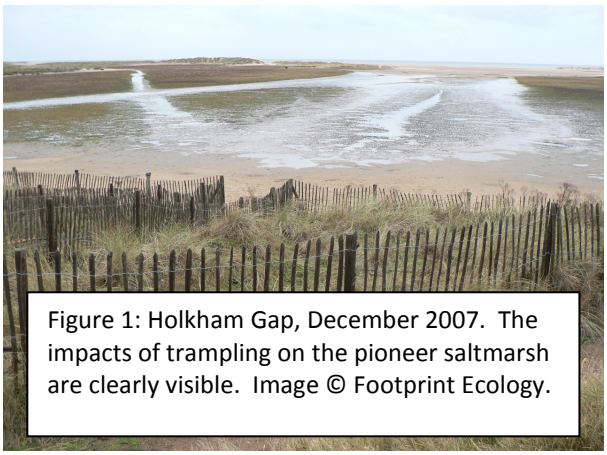


Figure 1: Holkham Gap, December 2007. The impacts of trampling on the pioneer saltmarsh are clearly visible. Image © Footprint Ecology.

These effects are visible in parts of the North Norfolk coast, for example at Holkham Gap (Figure 1), where the pioneer saltmarsh vegetation has disappeared in a large swathe where people walk to access the beach.

Our brief review of disturbance literature above illustrates that there is already an issue on some parts of the North Norfolk coast, and that problems could arise due to changes in visitor patterns, whether as a consequence of tourism policies and projects, or built development even at some distance from the coast.

5. Current housing stock and proposals for build development

The current distribution of housing within 50km of the North Norfolk Coast SPA is shown in Figure 2. Fifty km is easily within day-tripping distance and existing and new homes within this (and a greater) distance would be anticipated to increase visitor numbers (assuming occupancy rates of housing remain roughly constant).

It can be seen that there are currently relatively few houses immediately surrounding the North Norfolk Coast SPA. The current distribution shows a marked peak between 35 and 40km, with nearly 120,000 houses falling within this radius. This distance band includes central Norwich (a proposed Growth Point) and also towns the other side of the Wash, such as Boston – it does not therefore reflect travel distance accurately (people coming from Boston have considerably further than 40km to travel to reach the North Norfolk coast!). The peak is particularly attributable to Norwich. The Office of National Statistics gives average occupancy rates as 2.31[4], and therefore over 250,000 people currently live within this 35-40km band alone.

Predictions for growth in the UK population are provided by the Office of National Statistics[5]. The UK population is projected to increase by 4.4 million by 2016, an increase equivalent to an average annual rate of growth of 0.7 per cent. If past trends continue, the population will continue to grow, reaching 71 million by 2031. This is due to natural increase (more births than deaths) and because it is assumed there will be more immigrants than emigrants (a net inward flow of migrants).

The draft East of England Plan sets the context for future housing development in the broad region. Housing allocations (to 2026) for Norfolk are some 72,600 dwellings, for Suffolk 58,600 and for Cambridgeshire and Peterborough some 89,300.

[4] http://www.statistics.gov.uk/cci/nugget.asp?id=818
[5] http://www.statistics.gov.uk/cci/nugget.asp?id=1352

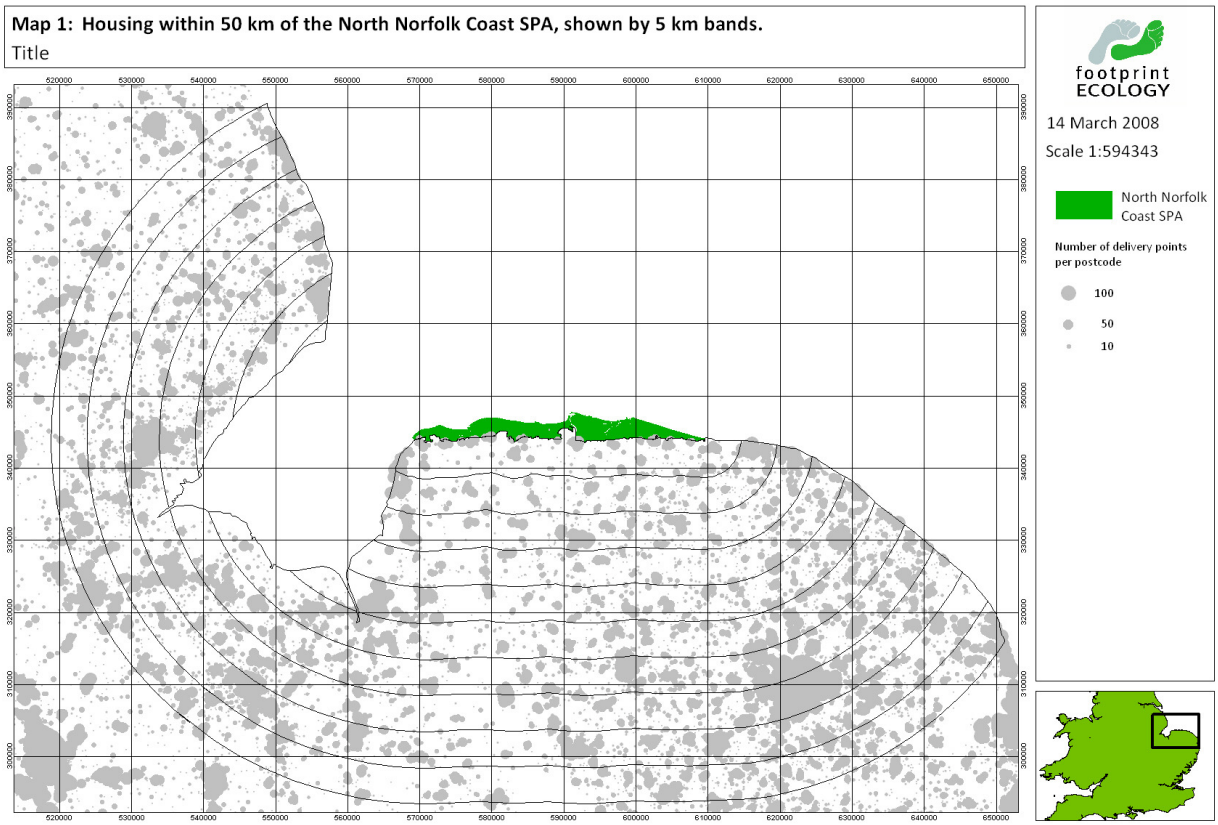
6. Links between access and housing

Various pieces of work in other areas have shown that there are links between housing and visitor numbers (e.g. Jones et al., 2003, Liley et al., 2006b). The work in Dorset, exploring visitor numbers to heathland locations, has shown that visitor numbers arriving on foot can be predicted from the number of houses surrounding each site, but that car-borne visitors are harder to predict. In the Dorset example (Liley et al., 2006a, Liley et al., 2006b), car-park size and housing was used to build models of visitor rates for car-borne visitors. It is clear, and perhaps intuitive, that a range of factors will influence where people choose to go in the countryside.

Choice of site will be determined by a range of factors that includes the choice of activity, the weather, the range of options / alternatives, travel distance, travel time, cost and facilities present at the site. New development has the potential to impact visitor access patterns in that it changes the spatial distribution of the human population, potentially increasing the number of people within a given radius. Increasing visitor numbers in one area may have knock-on consequences if it results in visitors being displaced, perhaps as sites reach capacity or become over crowded. Changing the distribution of housing may also result in changes in travel time to particular locations. Links between housing and access are therefore complex, but there are clear consequences for strategic planning where changes in access has the potential to have an adverse effect on European Protected Sites.

Given that the visitor studies show that nearly a third of visitors to the Norfolk Coast are day trippers coming from their homes, and we know that the average distance people travel to visit Cley is 96 miles (Klein and Bateman, 1998) it would seem likely that there will be clear increase in housing within the broad 'catchment' of the North Norfolk coast. Growth in housing at locations such as Kings Lynn, Norwich, Thetford and potentially further afield are likely to result in changes in visitor numbers to the North Norfolk coast area.

The effects of such growth will need to be considered through the Habitats Regulations Assessments of Core Strategies and other DPDs being prepared by the Local Planning Authorities. Given that built development in several Districts are likely to generate changes in visitor numbers to the coast, a strategic approach quantifying, and then avoiding and mitigating, any impacts would seem appropriate. This strategic approach must then be reflected through further analysis and policies at the LDF level.



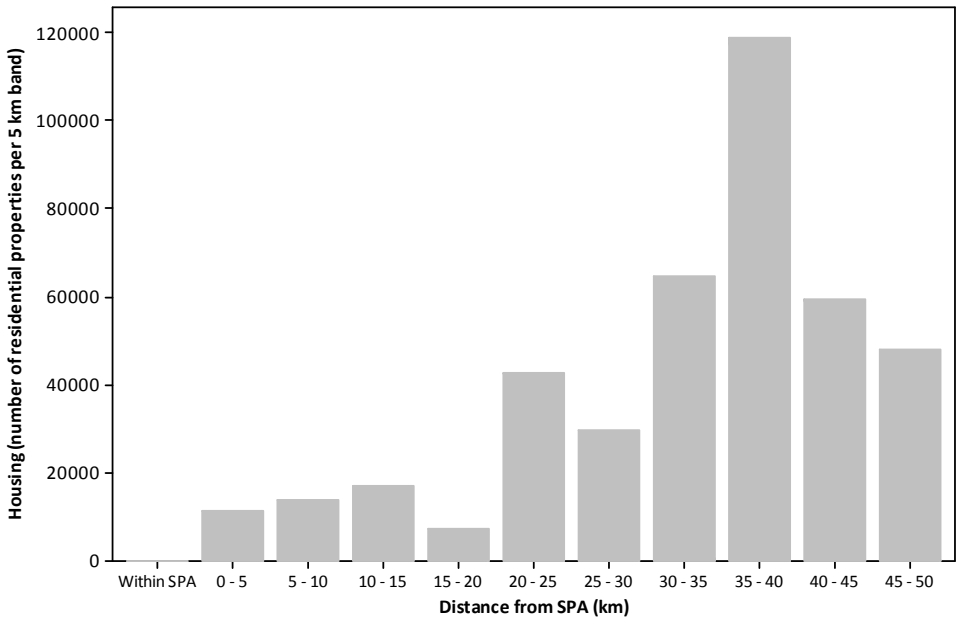


Figure 2: Current housing density in relation o distance from the North Norfolk Coast SPA. Housing data is the number of residential properties within successive 5km bands outside the SPA. Map shows postcodes (pale grey).

7. Additional factors

The following are also relevant issues with respect to future development and nature conservation issues on the Norfolk Coast. An assessment must consider such 'in-combination' and cumulative factors.

7.1 Coastal Access

Improving access to the English coast was a priority issue in Defra's five year strategy (published in 2004), and the Labour Party's Rural Manifesto of April 2005. In July 2005, Ministers proposed that action to improve coastal access should be an early "flagship" initiative for Natural England. The published vision for the project is to achieve "A coastal environment where rights to walk along the length of the English coast lie within a wildlife and landscape corridor that offers enjoyment, understanding of the natural environment and a high quality experience; and is managed sustainably in the context of a changing coastline." (quoted in Natural England, 2007).

It is currently unclear how access may change and specifically what changes may occur along the North Norfolk Coast, but any promotion of access routes or new routes are likely to potentially change the numbers and distribution of people along the coastline.

7.2 Climate change

Climate change is likely to affect both how people visit the countryside and the conservation interest of sites. Warmer weather, particularly at off-peak times, is likely to attract more people to holiday in the UK or to do more day trips. Coastal areas may well increase in popularity. There is already evidence of changes in distribution of birds in relation to climate change, but in many cases the population consequences will be difficult to predict (e.g. Norris *et al.*, 2004). There is little work that currently addresses the interactions between access, climate change and biodiversity (but see Tratalos *et al.*, 2005). Climate change will also result in changes to coastal habitats, with coastal squeeze potentially reducing the amount of coastal habitat, and therefore reducing the area of particular habitats and potentially squeezing people and wildlife into a narrower strip. Predictions of sea-level rise have been used to calculate the population consequences of habitat loss for Ringed Plovers, with a 50cm rise predicted to result in a decrease in population size of 10% for the Snettisham area (Liley, 1999).

8. Avoidance, mitigation and existing management initiatives

The visitor work described thus far is necessary to inform the type, design, scale and location of any initiatives necessary to reduce or contain visitor impacts. Until such work is done it is impossible to give specific recommendations, and in this section we therefore simply highlight some measures which may be part of a future suite of initiatives relating to access and disturbance impacts.

The provision of alternative sites for people to visit is being used in other locations, such as around the Dorset Heaths, to reduce the number of visitors to designated sites. Such provision clearly needs to target particular activities which take place on the protected sites. There is little potential to provide alternative sites for a long beach walk in outstanding scenery. However there may be scope for carefully designed sites targeted for particular groups such as dog walkers, windsurfers (gravel pits or similar), family outings etc. These alternative sites would either need to take the form of dedicated sites near the coastal strip or through the provision of natural green spaces within housing growth areas.

At the coast there is the scope for access management measures. These could include:

- Wardening – including the presence of site management staff within sites to give information, direct people and prevent damaging activities (such as dogs off-leads within tern colonies).
- Provision of access infrastructure, such as boardwalks, way-marked routes etc. Sand dunes and coastal vegetated shingle are likely to be the most important habitats to contain trampling and visitor pressure to particular routes.
- Creation of new routes and additional space for people to walk in areas where there are not necessarily any nature conservation impacts. This could include inland routes, inland viewpoints etc, moving some of the pressure away from the beach areas.
- Creating public exclusion zones – for example through fencing – around tern colonies and ringed plover nesting areas. Such zones may need reviewing regularly.
- Manipulation of car-parking provision - the location of car-parks, their capacity and the cost of parking can all be used to deter people from particular locations and attract them to other areas.
- Publicity – leaflets, guides, maps and signage can all be used to promote responsible access and highlight particular locations.
- Road closures – while likely to be highlighly contentious, the closure of roads to beach car-parks could reduce visitor pressure in some locations. Conducted in conjunction with the promotion of public transport this could help contain visitor increases to particular locations and in particular contain access to the coast for activities such as windsurfing or kite surfing (all dependent on vehicle access close to the beach).
- Zoning of water-based activities – the promotion of particular zones for jet skis, kite surfing etc would help contain these activities to particular locations.

The access management measures above will work to contain impacts and modify visitor numbers, attracting people to some locations and reducing the pressure at others. Some of the measures could be contentious, and there will be a need to work closely with regular visitors and the local community to ensure support.

Much of the coastline is under the management of various nature conservation organisations, including Natural England, the Norfolk Wildlife Trust and the RSPB. Visitor management already takes place, and visitors are actively encouraged in many locations. It is the wildlife that attracts the visitors in many cases. The existing visitor structures and management initiatives have evolved to cope with the current levels of visitors and ensure that people can access the areas important for wildlife.

A visitor management strategy was produced in 1995 by the AONB and, while no longer available, has been incorporated into successive documents, the 1998 AONB Management Strategy and now within the 2004-09 Management Plan.

It is suggested that the AONB Management Plan will provide a framework within which future access management, to avoid impacts, can be defined.

9. Financing

The work and measures described will cost money. In other areas, such as the Dorset Heaths and the Thames Basin Heaths, the planning system can be used both to build an appropriate evidence base and to put in place mitigation. In Dorset, the local planning authorities have developed a planning framework through which funds generated from developers are centralised through a strategic partnership and used to fund mitigation and monitoring. Relevant local authorities in the case of the Norfolk Coast include those in the Greater Norwich Development Partnership, King's Lynn, North Norfolk and Great Yarmouth. Each of these are responsible for delivering a level of growth in their planning area and thus a proportion of any increased visitor pressure on the coast.

10.Further work

We suggest the following as pieces of additional work necessary to increase our understanding and determine the scale of any impacts and management options.

1) Monitoring of key species

Accurate monitoring of key species and habitats should be established across a range of sites. Much of this work is already in place, but it should be co-ordinated in such a way as to ensure comparison between years and between sites. Ringed Plovers and other breeding waders, terns and salt marsh vegetation (at selected locations such as Holkham Gap) would be priorities for monitoring. A monitoring framework could be developed for and included within the AONB Management Plan. The various Districts should contribute financially to monitoring as this is required to demonstrate that mitigation measures are effective.

2) Visitor data

It is important to understand the current numbers of visitors to the coastal strip and where they come from. Such a piece of work would involve visitor counts at different locations and questionnaires, possibly involving a range of survey methods, such as car-park counts, visitor counts, questionnaires and possible postal surveys. The work would be targeted to specifically address the following:

- How many people visit the Norfolk coast
- What proportion of visitors are staying tourists, day trippers from home, second home owners or local to the area
- For each of the above groups, what are the reasons for their visit and which locations do they visit
- What routes do people take / where do they go within sites.

Questionnaires will form a key element in the work. The questionnaire should identify where people have been, routes taken on sites, why they have visited and where they have come from. Home postcodes are a useful way of determining where people have come from (for example see Clarke et al., 2006, Liley et al., 2006c). The questionnaire should be designed in such a way as to allow visitors to be grouped into different categories (locals, day trippers from home, etc). The visitor survey work would need to encompass a range of different times of year and days of the week.

In order to ensure that different groups are adequately sampled within the survey (such as second home owners and people involved in water-based activities) it may be necessary to specifically target such groups through postal surveys or surveys / questionnaires at public slipways.

As part of the visitor work it would be useful to repeat previous visitor monitoring in order to determine the extent to which access levels and types of access have increased. There is the potential to repeat the counts of people at Snettisham / Heacham conducted in the mid 90s (Liley, 1999) and possibly the work done by the RSPB in the late 90s (Rayment *et al.*, 2000). This element of the visitor work should be conducted in such a way to highlight any new types of access or types of access that may be becoming more common such as kite surfing, kite boarding etc.

These data will be required by the District Councils to enable them to complete Habitat Regulations Assessments of their various DPDs. A co-ordinated approach, defining what is needed and how each relevant local authority needs to contribute, is recommended.

3) Relating visitor data to future housing change

The visitor survey work should then be analysed in such a way to determine the likely changes in visitor numbers as a result of development. In order to do this it will be necessary to determine visitor rates from different distance bands. These rates should be calculated for different groups (such as birdwatchers, people visiting to sail, walkers etc). Of particular relevance will be those people visiting the area for day trips from their home.

By mapping changes in housing distribution, it should then be possible to determine how housing numbers will change within different distance bands, and therefore to make predictions as to how access patterns will change (for example see Liley et al., 2006b, Sharp et al., 2008).

4) Further understanding of visitor impacts

The enhanced understanding of how visitor numbers will change (as a result of 3 above) should then be related back to key species and the conservation interest of sites. Depending on the results of the visitor analysis (i.e. scale of impacts and types of impact) one or all of the following should be explored:

Previous work on Ringed Plover (Liley, 1999) used to provide a detailed case study of impacts of the changes in visitor numbers

Work looking at trampling of salt marsh and visitor access patterns at selected locations (potentially trialling different management measures such as boardwalks, exclosures etc).

Disturbance impacts of particular types of access (such as kite surfing, kite boarding or similar that might be highlighted in the visitor survey).

Review of access management measures (protection of tern colonies, zoning of activities, codes of conduct for different user groups etc) in place along the coastline, how these are implemented and where there is potential for improvement.

5) Avoidance and mitigation

Once a clear idea is available about current and potential future impacts, one can develop a spatially and temporally-explicit avoidance and mitigation package. This will properly emerge through the Habitats Regulations Assessments of the AONB Management Plan and the Core Strategies and various other DPDs being prepared by the relevant LPAs. Given that much of the mitigation will be 'on site', i.e. outside of some of the key LPA areas, perhaps the AONB Management Plan is the place to set out a comprehensive mitigation package.

6) Funding mechanisms

It is suggested that a brief review of funding mechanisms be undertaken, looking particularly at the role of forward planning and development control in setting down the policy framework.

11. Appendix 1: Details of the Natura 2000 sites and designations

North Norfolk Coast SAC

The North Norfolk Coast qualifies as an SAC for the following Annex I habitats:

- Mediterranean and thermo-Atlantic halophilous scrubs (*Arthrocnemetalia fructicosae*);
- Coastal lagoons;
- Perennial vegetation of stony banks;
- Embryonic shifting dunes;
- Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes');
- Fixed dunes with herbaceous vegetation ('grey dunes'); and
- Humid dune slacks.

In addition there are two Annex II species (Otter *Lutra lutra*; and the liverwort *Petalophyllum ralfsii*) which are present as a qualifying feature, but not a primary reason for site selection.

The Wash and North Norfolk Coast SAC

This SAC in large part coincides with the North Norfolk Coast cSAC but is designated to cover a range of other marine and coastal habitat types:

- Sandbanks which are slightly covered by sea water all the time;
- Mudflats and sandflats not covered by seawater at low tide;
- Large shallow inlets and bays;
- Reefs;
- *Salicornia* and other annuals colonising mud and sand;
- Atlantic salt meadows (Glauco-Puccinellietalia maritimae); and
- Common seal *Phoca vitulina*

North Norfolk Coast SPA

The mosaic of coastal and wetland habitats along the North Norfolk coast supports important populations of birds throughout the year. The SPA qualifies by supporting:

Table 4: Qualifying species for the SPA, breeding season. Data summarised from JNCC website[6]

Species	***Number***	***Importance - % of GB count or other area as stated (yr of count)***
Avocet *Recurvirostra avosetta*	177 pairs	30.0% (1998)
Redshank *Tringa totanus*,	700 pairs	1.2% of the breeding Eastern Atlantic - wintering population (1998)
Ringed Plover *Charadrius hiaticula*	220 pairs	1.4% of the breeding Europe/Northern Africa - wintering population (1998)

[6] http://www.jncc.gov.uk/default.aspx?page=2008

Bittern *Botaurus stellaris*	3 individuals	15% (1998)
Common Tern *Sterna hirundo*	460 pairs	3.7% (1996)
Little Tern *Sterna albifrons*	377 pairs	15.7 (5 yr peak mean 1994 – 1998)
Marsh Harrier *Circus aeruginosus*	14 pairs	8.8% (1995)
Mediterranean Gull *Larus melanocephalus*	2 pairs	20% (1996)
Roseate Tern *Sterna dougallii*	2 pairs	3.3% (5 yr mean 1994 – 1998)
Sandwich Tern *Sterna sandvicensis*	3,457 pairs	24.7% (5 year peak mean 1994-1998)

Table 5: Qualifying species for the SPA, winter. Data summarised from JNCC website[7]

Species	***Number***	***Importance - % of GB count or other area as stated (yr of count)***
Avocet *Recurvirostra avosetta*	177 individuals	12.0% (1997/8)
Bar-tailed Godwit *Limosa lapponica*	1,236 individuals	2.3% (5 year peak mean 1991/2 - 1995/6)
Bittern *Botaurus stellaris*	5 individuals	5.0% (5 year peak mean 1993/4 - 1998/9)
Golden Plover *Pluvialis apricaria*	2,667 individuals	1.1% (5 year peak mean 1991/2 - 1995/6)
Hen Harrier *Circus cyaneus*	16 individuals	2.1% (5 year mean 1993/4-1997/8)
Ruff *Philomachus pugnax*	54 individuals	7.7% (5 year peak mean 1993/4 - 1998/9)
Dark-bellied Brent Goose Branta bernicla bernicla	11,512 individuals	3.8% of the wintering Western Siberia/Western Europe population (5 year peak mean 1991/2 - 1995/6)
Knot Calidris canutus	10,801 individuals	3.1% of the wintering Northeastern Canada/Greenland/Iceland/Northwestern Europe population (5 year peak mean 1991/2 - 1995/6)
Pink-footed Goose Anser brachyrhynchus	23,802	10.6% of the wintering Eastern Greenland/Iceland/UK population (5 year peak mean 1991/2 - 1995/6)
Pintail *Anas acuta*	1,139 individuals	1.9% of the wintering Northwestern Europe population (5 year peak mean 1991/2 - 1995/6)
Redshank *Tringa totanus*	2,998 individuals	2.0% of the wintering Eastern Atlantic - wintering population (5 year peak mean 1993/4 - 1997/8)
Wigeon *Anas penelope*	14,039 individuals	1.1% of the wintering Western Siberia/Northwestern/Northeastern

[7] http://www.jncc.gov.uk/default.aspx?page=2008

	Europe population (5 year peak mean 1991/2 - 1995/6)

Table 6: Qualifying species for the SPA, on pasage. Data summarised from JNCC website[8]

Species	***Number***	***Importance - % of GB count or other area as stated (yr of count)***
Ringed Plover *Charadrius hiaticula*	1,256	2.5% of the Europe/Northern Africa - wintering population (5 year peak mean 1994/5 - 1998/9)

The area qualifies under Article 4.2 of the Directive (79/409/EEC) by regularly supporting at least 20,000 waterfowl (5 year peak mean 1991/2 - 1995/6 was 91,249 individuals)

In addition to the coastal habitats described in previous sections dealing with the two SACs there are also habitats to landward (designated SPA and Ramsar) of the shoreline that provide an important resource for breeding and wintering bird populations. These habitats include a network of grazing marsh, pasture and reedbed.

North Norfolk Coast Ramsar site
The coastline is designated as a Ramsar site for its diverse and extensive wetland habitats and associated species (mostly birds). The Ramsar boundary effectively matches the SPA and encompasses a variety of habitats including intertidal sands and muds, saltmarshes, shingle and sand dunes, together with areas of reclaimed freshwater grazing marsh and reed bed. The designation applies under the following criteria:

Ramsar criterion 1a
The site is one of the largest expanses of undeveloped coastal habitat of its type in Europe. It is a particularly good example of a marshland coast with intertidal sand and mud, saltmarshes, shingle banks and sand dunes. There are a series of brackish water lagoons and extensive areas of freshwater grazing marsh and reed beds.

Ramsar criterion 2a
Supports at least three British Red Data Book and nine nationally scarce vascular plants, one British Red Data Book lichen and 38 British Red Data Book invertebrates.

Ramsar criterion 3a
Over the winter the site regularly supports over 20 000 waterfowl (see Section 2.3 for details).

[8] http://www.jncc.gov.uk/default.aspx?page=2008

Ramsar criterion 3c

During the breeding season the site regularly supports:
Little Tern, (Eastern Atlantic (breeding))
Common Tern, (Northern/Eastern Europe (breeding))
Sandwich Tern, (Western Europe/Western Africa)
Over the winter the site regularly supports:
Dark-bellied Brent Goose, (Western Siberia/Western Europe)
Knot, (Northeastern Canada/Greenland/Iceland/Northwestern Europe)
Wigeon, (Western Siberia/Northwestern/Northeastern Europe)
Pink-footed Goose, (Eastern Greenland/Iceland/UK)

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