

Technical Annex 12H
Status

Hayle Harbour Aquatic Avifaunal

**Hayle Harbour:
Aquatic Avifaunal Status**

Report to The Environment Practice

Institute of Estuarine
and Coastal Studies
University of Hull

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The Environment Practice

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1. INTRODUCTION

The following sections address the potential impacts to the aquatic avifauna of the Hayle Estuary and associated sites, in relation to the proposed development.

The Existing Environment section provides an overview of the current status of the area for key waterfowl species, including details of the findings of the ornithological monitoring programme undertaken at the site over the last year, together with information on species from previous monitoring programmes as applicable.

In addition to providing an overview of waterfowl usage in the Hayle Estuary on a key species basis (relative abundances on component areas of the estuary, seasonal patterns and habitat function), the section also describes the current level of disturbance stimuli experienced by waterfowl in the Hayle on a sectoral basis (type, frequency and response). As such, it is expected that these data will allow a more accurate prediction of potential disturbance related impacts to waterfowl to be ascribed to the proposed development activities (i.e. the magnitude of direct and indirect impacts, permanence of effect, reversibility of impact etc) as well as to better inform the wider impact mitigation process as necessary.

2. EXISTING ENVIRONMENT

Much of the Hayle Estuary complex is included within the statutory boundary of the Hayle Estuary & Carrack Gladden SSSI. In addition, the majority of the intertidal and subtidal area of the system is included within the St Ives Bay Sensitive Marine Area.

In addition to the statutory designations, much of the SSSI, Lelant Water, Ryan's Field, Carnsew Pool and Copperhouse Pool, comprises the RSPB Hayle Estuary Nature Reserve, whilst the estuary has also been designated as an Area of Great Scientific Value (AGSV) by Cornwall County Council (the Hayle to Godrevy AGSV).

A number of ornithological monitoring programmes have been conducted within the Hayle Estuary in recent years, both in relation to potential development programmes in the estuary, and as part of the national Wetland Bird Survey (WeBS) programme.

2.1 Historical Data for Key Sites

The following text provides a brief overview of key sites for waterfowl around the Hayle estuary, based on historical data. A more detailed appraisal of the historical information (in particular data from the 2000/1 dedicated monitoring programme) is provided in a stand-alone document (Evans *et al*, 2002). The information from these data were then used to inform and derive the current waterfowl monitoring programme at the estuary, which commenced in December 2004.

2.1.1 LELANT WATER (INCLUDING RYAN'S POOL)

The extensive intertidal mudflat and saltmarsh of Lelant Water was identified as being an important feeding and roosting ground for a number of wildfowl and wader species, with between 60 and 120 Shelduck (*Tadorna tadorna*) using the area during the winter months over the tidal cycle. The site was also of key importance for Wigeon (*Anas penelope*) with flocks of around 500 regularly noted in the winter, and Teal with around 100 birds present. Mallard (*Anas platyrhynchos*) also showed a strong preference for Lelant Water, with up to 20 birds present. Mute Swan (*Cygnus olor*) were also recorded on the site over the majority of the year, with most birds either using the western end of Lelant Water or Copperhouse Pool. In general, Lelant Water, and in particular, the western end of the site, appears to have been the preferred site for wildfowl within the Hayle complex, with most birds showing a strong fidelity to the area over the tidal cycle, with both feeding and loafing flocks present over the tide and a low degree of movement into other areas in response to inundation.

Lelant Water was also found to be of key importance for a number of wader species, with intertidal areas of the site being of particular importance for Oystercatcher (*Haematopus ostralegus*), Grey Plover (*Pluvialis squatarola*), Dunlin (*Calidris alpina*), Lapwing (*Vanellus vanellus*), Ringed Plover (*Charadrius hiaticula*) and Curlew (*Numenius arquata*) during the monitoring programme, with flocks using the site during both low and high water periods depending on tide state, with the western sections of the site of particular importance over the tidal cycle, and with low water concentrations on the south-western section of Lelant Water. Over the high water periods, roosts were established on Lelant Saltings in particular with Griggs's Quay and the Causeway of slightly less importance for most

species, and with flocks of some species (e.g. Dunlin, Redshank (*Tringa totanus*) and Curlew) moving onto Ryan's Field.

From the 2001/2 programme (Evans *et al*, 2002), the area was not found to be of national importance for any key waterfowl species although concentrations of Shelduck, Wigeon, Ringed Plover, Lapwing and Dunlin were of regional note. The site functions therefore, both as a feeding resource and roost for wildfowl, and is of key importance for the function of the Hayle system in terms of the associated waterfowl assemblage.

2.1.2 CARNSEW POOL

Carnsew Pool represents an extremely interesting and important habitat within the context of the estuarine system and the wider region, including, as it does, a substantial volume of open seawater, available over the entire tidal cycle, with an area of intertidal habitat exposed over each tide at the west of the pool. The pool was identified as being of particular importance for wintering Little Grebe (*Tachybaptus ruficollis*), with survey data from the 2000-2001 season for the area indicating a peak usage during January with up to 20 birds present, and with over 10 birds present between December and February. Carnsew Pool supported around two thirds of this population, and the birds were present on the pool over the tidal cycle, with concentrations at low water (Evans *et al*, 2002). These maxima accord well with WeBS data for the area which suggest between 15 and 20 Little Grebe use the area, with peak usage occurring between November and February. In addition, the Carnsew Pool was used by diver species and other grebe species on occasion, as well as wildfowl. Such a utilisation would be expected, given the retention of relatively deep tidal waters within the pool over the tidal cycle, with the 2000-2001 data having identified concentrations of the species to be towards the eastern end of the pool, *i.e.* the area of deeper water.

Small numbers of waders were also recorded within the Carnsew system, predominantly around low water when the area of mudflat at the western end of the site is exposed by the tide. Grey Plover, Dunlin and Bar-tailed Godwit (*Limosa lapponica*) were recorded on the site, although at a level below that of adjacent intertidal habitat.

The 2001/2 programme identified the Carnsew Pool area to be of particular importance for Little Grebe at a regional level, as well as other grebes and divers on occasion. This importance largely stems from the continual presence of saltwater habitat with an associated fish and invertebrate assemblage in an essentially artificial position within the estuarine system. The habitat is of particular value during winter hard weather periods.

2.1.3 COPPERHOUSE POOL

This area of intertidal habitat is located at the north-eastern extent of the site. The pool bordered by roads and a public right of way, with residential property along its southern extent. It is tidal, but with a sluice system which is activated on a few weekends a year to impound water for recreational activity.

The 2001/2 monitoring programme recorded a relatively low level of waterfowl usage compared to Lelant Water, but with the area of relatively high importance for Mute Swan, Shelduck, Oystercatcher, Ringed Plover and Redshank, with usage recorded at both low

and high water periods, the eastern sector of the pool increasing in importance around high water, and with areas of mud and marsh remaining uncovered on most tides.

Whilst supporting a characteristic avifauna for the area, numbers recorded from the pool were generally at a lower level than other sites within the Hayle system, and in particular, Lelant Water.

2.1.4 GENERAL FINDINGS

Little Egret (*Egretta garzetta*) were recorded around the Hayle site with no particular concentration recorded at low water, but with the south-western corner of Lelant Water featuring a concentration around high water. Up to around 20 birds were recorded in the autumn, but with a mean for the programme of 6 birds at low water. The programme identified a potential for a further increase in the status of the species at the site, given the expansion of the Little Egret population and range in the UK.

The programme did not record any significant changes in usage on different tide heights (neap vs spring), with no relationship noted between shorebird distribution and the height of high water. This would appear to indicate that sufficient roost area was available on all tides. Similarly, the programme did not identify any differences in waterfowl distribution under different weather conditions (particularly wind).

However, disturbance was recorded as being a significant influence on waterfowl behaviour and distribution. Dog walking was recorded as being the most frequent activity to elicit a behavioural response in waterfowl (a disturbance event) across the system as a whole, with Lelant Water featuring the greatest frequency of disturbance, arising from a variety of sources, both around high and low water. Disturbance events resulting from raptor or helicopter overflights were however noted as having the widest impacts, often affecting the entire estuary. It was observed that roost activity by Ringed Plover, close to a public right of way along Carnsew Pool, increased during a period when the footpath was closed to the public, suggesting that in addition to directly identifiable disturbance events (flocks put to flight etc), there is a behavioural response to human activity in some instances that is not readily identifiable, this response largely relating to distribution of flocks and site usage.

Based upon the findings of the programme described briefly above, a further waterfowl monitoring programme was initiated at the site to run from December 2004 to November 2005, this programme recording overall system usage by waterfowl on the same sectoral basis as the 2000/1 programme. As such, the 2004/5 programme allows a direct comparison with the data collected from the 2000/1 programme. However, in addition, a greater emphasis was placed within the methodology, on the collection of disturbance related information, given the proposed developments at the site.

2.2 Species Accounts

The following accounts are based largely on the findings of the current monitoring period (2004/5), but with reference to the 2000/1 programme (Evans *et al*, 2002) and other data as appropriate. The account describes the status of the species at the site on a spatial and temporal basis, and describes key aspects of behaviour in the context of the site, together with an indication of functional usage of areas of the estuary for that species, in

the context
of their wider behaviour. The text should be cross referenced to the spatial and temporal
data, presented on the individual species maps pages of this report.

2.2.1 LITTLE GREBE

Characteristically a bird of inland ponds and lakes, the species also occurs in estuaries and semi-enclosed marine bays in large numbers. The species feeds on fish, caught by diving and can be affected by periods of hard weather when inland sites can freeze over. WeBS data suggest that the species has been undergoing a steady increase in numbers for some time, although this may to some extent reflect changes in survey coverage, as many birds are in locations outside the normal area of WeBS coverage.

The distribution of the Little Grebe was found to be closely correlated to the availability of standing water, not unexpected given their largely fully aquatic requirements (Figure 1). During the monitoring programme the species was found to be confined to the Carnsew Pool, Harbour and Copperhouse Pool areas. The highest feeding maxima (8 birds) having been recorded on Carnsew Pool around low water in February, with a further 4 birds recorded in the Harbour and 6 on Copperhouse Pool during the month. Overall registrations peaked in February, but over 10 birds were present on the system between December and March inclusive. High water distribution was found to be broadly similar to that of low water, with concentrations in Carnsew and Copperhouse Pools, but with marginally lower maxima during the mid winter. The majority of records were for actively feeding birds, but with a roost of 4 recorded on Carnsew Pool in February. Overall usage patterns were similar to those of low water, but with a small number of birds (4 individuals) also present in April.

Average usage over the year was similar for Carnsew and Copperhouse Pools, with the registrations for Carnsew being from the eastern end of the pool, in the area of deeper water, closer to the sluice, and from the western end of Copperhouse, an area featuring greater water depth, again in the vicinity of the sluice. Usage in the Harbour was at a slightly lower level. Density values would equate to between 10 and 20 birds per km² for sections of Carnsew and Copperhouse Pools, and 5 to 10 birds per km² in the Harbour.

The results of the 2004/5 monitoring study described above are very similar to the findings of the 2000/1 programme (Section 2.1), with Little Grebe usage on the site restricted to the areas of permanent, saltwater, and with usage concentrated to the winter months. Peak usage was greater in the 2000/1 period, with a peak of 19 Little Grebe recorded, although average usage was comparable over the winter.

The national importance threshold for the species stands at 30 individuals, and as such, the site is not of national importance based on the monitoring study data. However, the Hayle Estuary, and in particular Carnsew and Copperhouse Pools are undoubtedly of regional importance, and during periods of hard weather, may take on national importance, given the relatively unique conditions present in the Carnsew Pool in particular. This pool features a relatively deep saline habitat, with associated benthic invertebrate and pelagic fish assemblages, with the water exchanged daily, a habitat not frequently present in an upper estuarine location. As such, the waters of the pool will remain largely unfrozen during hard weather, when other areas of freshwater, or which have less frequently exchanged saltwater, would freeze over. This relatively unique feature means that during hard weather periods, the pool will become increasingly important for the species, with an influx of birds from elsewhere in the region (as well as other species having similar habitat requirements). Such hard weather conditions have not been experienced in recent years, and in general the winter of 2004/5 was relatively mild. As such, a greater abundance of

Little Grebe might be expected to use the area in colder winters or hard weather events, and the need to consider this within the impact assessment will be discussed in Sections 3 and 4 as appropriate. The proximity of the pool to the main development area, as well as the potential for works and after use to affect flow regimes into and out of the pool entails that further consideration to impacts to the species is given in the following sections.

2.2.2 MUTE SWAN

The 2000/1 programme recorded an average of 20 Mute Swan on the estuary, with concentrations at the western end of Lelant Water and in Copperhouse Pool, and around 20 birds present in all in late summer. A peak of over 40 birds was recorded in February, and although this figure is well below the national importance threshold of 260 birds, the system might be considered of regional importance based on these data.

However, the current monitoring period 2004/5 recorded a lower number of birds on the system, with between 5 and 10 birds usually present at low water, and with similar numbers around high water. Low water usage was concentrated on Copperhouse Pool, and in particular the zone nearest to the sluice (Figure 2). Lelant Water was relatively unimportant compared to Copperhouse usage, although 2 birds were generally present during the autumn. Low water usage on the western part of Copperhouse equated to an average of between 10 and 20 birds per km², with the central area of Copperhouse at 5 to 10 birds per km². At high water Copperhouse remained the key site for the species within the system, with up to 8 birds feeding.

It would appear that the reduction in overall numbers at the site between the two count programmes is to some extent related to the reduction in the status of Lelant Water for the species. However, the reasons for this decline, albeit slight, are not clear.

2.2.3 SHELDUCK

The Shelduck is a characteristic bird of estuaries, and feeds in areas of soft mud, by filtering out small invertebrates from the sediment by forcing it through small teeth like structures in the bill. It feeds on a variety of invertebrates, although apparently prefers *Hydrobia ulvae* (Mud Snail) if available. The species undergoes a post breeding moult, with individuals undergoing substantial migratory movements to moult grounds at this time.

The 2000/1 programme recorded a maxima of over 120 Shelduck on the site, with the majority of usage recorded from January to May, peaking in March. Distribution of the species was clustered around Lelant Water, but with Copperhouse Pool also used to a lesser extent, as well as most other sites around the estuary. A similar abundance and distribution was observed between low and high water periods.

The 2004/5 monitoring programme also recorded the Lelant Water area as being of key importance for the species within the Hayle system, but with the central section of Copperhouse Pool supporting the greatest density of birds (Figure 3). In general, recorded maxima from the current programme were slightly higher than for 2000/1 during the late winter with over 150 birds recorded on the site in February and March, and with the central section of Copperhouse recording the maxima during these months, with over 80 birds on the zone in March, the majority of these feeding. In fact the low water density for Shelduck on the central section of Copperhouse Pool was between 100 to 150 birds per km², compared to the western part of Lelant Water at 50 to 100 birds per km². This slight change in site importance between the two monitoring periods is of interest, as the central section of Copperhouse was found to be relatively unimportant for the species in 2000/1. In an absence of any notable change in external influences (site availability, disturbance etc), this may reflect a change in prey availability in the sectors of the site, although experience in monitoring site usage on mudflats within other estuaries, e.g. the Humber, has found the species to be relatively mobile in distribution between sites within a mudflat complex without any significant variability in prey availability, the change in usage if anything, apparently linked more to sediment conditions than change in prey.

As with the 2000/1 programme, high water usage was found to be largely in the same areas as that at low water, with Lelant Water and Copperhouse Pool supporting the majority of the assemblage, with around 100 birds present in the late winter, reducing to a population of around 30 to 40 birds by the breeding season, a similar level to that from 2000/1. High water concentrations were noted on the Lelant Saltings, Lelant Causeway and the upper reaches of Copperhouse Pool. Interestingly however, whereas high and low water maxima were broadly comparable during the 2000/1 programme, high water totals were generally below those of low water from the 2004/5 data, suggesting that some birds are moving into the area to feed around low water. This to some extent would account for the slightly increased usage at low water, although there are no observational data to assist this hypothesis.

Again, the maxima recorded for the site is well below the national importance threshold for the species, but is considered of regional importance, both for wintering and breeding flocks.

2.2.4 WIGEON

The species is often associated with estuarine habitats in the autumn and winter and has undergone an increase in population at a national level over a prolonged period. The species tends to feed in flocks, 'grazing' areas of short sward (often *Festuca rubra*), known as 'Wigeon lawn', or on algal covered intertidal mud, usually *Enteromorpha* spp. It has a strong site fidelity to these feeding areas, and often roosts close by, and as such is potentially more susceptible to significant impacts from disturbance or other activity, if this is undertaken close to a habitually used area.

The Wigeon was the most abundant species of wildfowl using the site during the 2000/1 programme, although the peak of over 1,200 recorded on one occasion in February was probably a result of double counting, and a winter population of around 400-600 birds was probably more realistic, with little variation in maxima between high and low water. The species was absent from the site between April and late August, with peak usage between November and March, and the majority of birds recorded at the western end of Lelant Water.

The 2004/5 programme recorded the greatest density of birds on site 4, the zone between Lelant village and Carnsew Pool, with between 500 to 600 birds per km² using this area at low water, but with the main area of Lelant Water also supporting a relatively high density, with between 250-500 birds per km² recorded (Figure 4). Sections in the outer Hayle and Copperhouse Pool were also used, with a density of 100 to 250 birds per km². Roosting flocks of between 300 and 400 birds were observed on sections 2, 3 and 4 between December and February inclusive, with a peak flock of 455 on section 3 (Lelant, SW of Carnsew) in December and to some extent these sections were also key for feeding activity. However section 3 was not particularly important for feeding flocks, with section 1 (western Copperhouse) of relatively high importance for feeding around low water, and with section 12 (eastern Copperhouse) also supporting a feeding flock of 300 in March. Around high water, section 1 (Ryan's Field) was often used as both a roost and feeding resource, with up to 774 birds (February) feeding in the zone around high water, and with feeding flocks of over 500 on Copperhouse and 425 on Grigg's Quay in the same month.

Despite the relatively large flocks using the Hayle system, the species is not present in nationally important numbers, but the site is considered of regional importance for the species. The Wigeon tends to habitually use a series of feeding and roosting sites, and as such, can be readily affected by disturbance, particularly if this occurs over a protracted period, when a key feeding or roosting site might be excluded from the system. As such, it will be important to minimise the effects of disturbance to the species over the winter period. This will be discussed further in the relevant impact and mitigation sections of this document.

2.2.5 TEAL

The Teal is associated with estuaries and inland wetlands during the winter, moving to upland inland sites to breed in the spring. In general the national trend for the population has been one of increase over the last few years, although with fluctuations between years.

The 2000/1 data recorded a peak of around 300 birds, although this was probably due to double counting, with a flock of between 100 and 200 birds generally present over the late autumn and winter period. As with most wildfowl, there was little variation recorded between low and high water periods in terms of abundance and distribution, with the western end of Lelant Water of particular importance for the species, but with Copperhouse Saltings also used.

The 2004/5 programme recorded a very similar pattern of distribution, with the western end of Lelant Water having the highest low water density (100-200 birds per km²), but with Copperhouse Saltings supporting a density of between 50-100 birds per km². Peak usage occurred between December and February inclusive, with flocks of over 300 using the western end of Lelant water for roosting, and with smaller flocks using both this zone and Ryan's Field to feed at low water (Figure 5). Ryan's Field was also used as a high water roost on occasion, but by a relatively small number of birds.

Around high water, feeding was carried out on Lelant Saltings, Grigg's Quay, Ryan's Field, Lelant Causeway and Copperhouse Pool, with Lelant Saltings and Grigg's Quay supporting the greatest number of birds and being used more regularly over the winter. High water roosts were established on Lelant Saltings and Lelant Causeway in particular, with flocks of up to 244 and 156 recorded respectively.

As with other wildfowl using the Hayle, recorded maxima were well below the national importance threshold of 1,400 birds, with the site probably of regional importance for the species. However, some sizeable feeding and roosting flocks were recorded from several locations around the estuarine system of the Hayle, the majority of these at the western end of the site (Lelant Water and associated wetland sites). Teal can be susceptible to disturbance, as well as external factors, including hard weather. In addition, although they have a catholic diet, they are often habitually associated with key feeding areas within an estuarine system, and adjacent suitable habitat. This would appear to be the case from the available data for the Hayle, with high and low water relative maxima for key sites being similar. The distribution and likely impacts to the population will therefore need to be addressed in detail within the impact and disturbance sections of this report.

2.2.6 MALLARD

Mallard are generally associated with estuaries and inland wetland sites, and can feed on a variety of small aquatic prey, as well as vegetable matter. In the autumn in some areas they will feed on grain in the stubble of inland fields. The species has undergone a decline at a national level in recent years, the reasons for the decline not fully understood, but linked to different agricultural practices and loss of wetland habitat.

Mallard usage was identified as being relatively low during the 2000/1 campaign, with patchy records for the species over the winter, and the annual maxima recorded in September (around 20 birds), with autumn usage generally greater than that of the winter. This is often the case, with post breeding usage in the autumn seeing the peak on estuaries, with some onward movement to other sites by the winter, although this can be influenced by weather conditions, with increases in estuarine usage and a south-westerly movement in hard winters (including on some coasts an influx of continental birds). The 2000/1 programme recorded Lelant Water as being the key site for the species within the Hayle system with small numbers also using Copperhouse Pool.

A similar, relatively low level of usage was recorded during the 2004/5 programme, with only small flocks or, more frequently pairs, recorded (Figure 6). Copperhouse Pool and the western end of Lelant Water were the key sites for the species at low water, although only featuring very small numbers, albeit on a regular frequency. High water also recorded a low level of usage, with small numbers around Lelant Water and in Copperhouse Pool.

Mallard numbers have been of concern at a national level for a number of years, there having been a substantial and steady decline in numbers at a national level since the mid 1980s. As such, although the Hayle is not an important site for the species, consideration should be given to the minimisation of disturbance to the species. As the distribution and broad habitat requirements of the species are similar to those of other wildfowl, this will be covered at a generic level in the following sections.

2.2.7 OYSTERCATCHER

The species tends to be recorded on estuaries and coasts and can take a variety of prey items, although *Cerastoderma edule* (Cockle) and *Macoma balthica* (Baltic Tellin), as well as barnacles and mussels often constitute a substantial component of the diet. As such, the species can be affected by over fishing of its prey items (in particular cockles), although the population at a national level has remained relatively stable in recent years.

The 2000/1 programme identified substantial differences between low and high water maxima, with this attributed to a variety of factors including inland feeding sites and tidal influence. Over 60 birds were recorded on several occasions on the estuary, but with between 20 and 40 birds more usual, with numbers present at this level for the majority of the year, with only June and July featuring consistent maxima of less than 10 individuals. The majority of Oystercatcher were recorded feeding on Lelant Water around low water, with additional birds using Copperhouse Pool. High water distribution was broadly similar, although presumably with some movement within the zone, e.g. onto Lelant Saltings from Lelant water, in response to tidal inundation. Usage on Carnsew Pool was recorded as being low throughout the tidal cycle.

Similar overall numbers were recorded from the current monitoring programme, with several individual sectors supporting between 15 and 20 birds, in particular, the eastern section of Copperhouse Pool, the western section of Lelant Water and Ryan's Field, the latter largely for roosting birds (Figure 7). Peak usage of these zones was not clustered, with records in excess of 15 birds from the winter, as well as late summer. However, it is of note that the greatest density of usage at low water was for Carnsew Pool, with roost flocks of up to 10 birds recorded, as well as regular small numbers of feeding birds, this level of usage not picked up from the 2000/1 programme. The distribution and density figure for the species shows that the species was generally well distributed across the site at low water, both in terms of numbers and average density. However, as could be expected for wader species, high water usage was more clustered, with roost and feeding flocks concentrated on sections 1 (Lelant Saltings) and 7 (Copperhouse Pool). Notably, a roost flock of 33 birds was recorded on Copperhouse Pool in December, with 28 roosting on the section in January. July recorded 28 birds roosting on Lelant Saltings, with 22 birds feeding on the same zone in April and May, emphasising the relatively stable level of usage by the species on the site throughout the year. Interestingly, summer usage was generally much higher in 2004 than for the 2000/1 programme, possibly indicating increased breeding potential in the area, although non-breeding juveniles can concentrate on estuaries during the summer, in addition to those individuals breeding in the area.

Given the national importance threshold of 3,600 birds, clearly the Hayle is of relatively low importance. However, sectors within the system can support locally important numbers, particularly during high water compression periods, these sites predominately being the extreme western end of Lelant Water and the eastern end of Copperhouse Pool, both areas being some distance from the main area of proposed development activity.

2.2.8 RINGED PLOVER

As species predominantly associated with estuaries and coasts, Ringed Plover can be found on a variety of substratum, from mud, through sand to cobble. Although for many sites the peak maxima can occur during the winter, the species has a relatively late passage timing in the spring, with substantial flocks often recorded in May and then again in August on return passage. WeBS data suggest that the national population has been in decline for some years although at a flyway level, the population has undergone an increase.

The 2000/1 programme identified winter usage at around 80 birds at low water, but with numbers increasing at high water to 148 on one occasion in December, (this suggested as being a result of birds moving into the area from adjacent coastal habitats). Lelant Water tended to be the preferred area for the species with additional birds using Copperhouse Pool and Carnsew Pool on occasion. The main high water roost was on the Lelant Causeway sector.

Usage on the site during the current monitoring period was generally at a substantially reduced level to that of 2000/1. Around low water feeding was concentrated on the zone between Lelant village and Carnsew Pool, but with roosting activity peaking in the outer estuary, with up to 40 birds recorded in this area during the winter, (equating to between 75-100 birds per km²). At high water feeding continued on the Lelant Causeway sector, with up to 29 birds recorded in March, as well as 31 birds on the Triangular Spit sections in September (Figure 8). Roosting activity at this time as infrequent, but flocks of over 30 birds were recorded from the Triangular Spit section in August and September, these presumably birds on return passage.

Numbers recorded from the Hayle system in 2004/5 were well below the national importance threshold, and slightly below levels recorded from 2000/1. The site is of local importance for the species, particularly with the potential for birds to move into the site around high water from adjacent coastal sites, in order to continue feeding as well as roost. Whilst numbers in the system are relatively low, it would appear that their preferred feeding and roosting areas are towards the central area of the site, in particular Lelant causeway and the Triangular Spit. As such, they will need to be addressed within the impacts and disturbance sections of the report, at least within local context.

2.2.9 GOLDEN PLOVER

The Golden Plover is a species which often uses estuarine habitats as a roosting area, feeding primarily on inland fields although on passage and during hard weather periods, the flocks will also feed on the intertidal zone. As such, numbers recorded on estuarine sites can vary substantially both on an intra and inter annual basis.

The 2000/1 programme recorded Golden Plover primarily during late January and early February, with up to 900 birds present on the western end of Lelant Water.

A similar pattern of short duration usage was seen in 2004/5, with a roosting flock of 734 birds recorded on one occasion in February on Ryan's Field (Figure 9). The presence of a flock of similar size was also recorded on a site visit outwith the monitoring programme in the winter of 2004/5, the flock being on the western Lelant Water section adjacent to Ryan's Field on this occasion. In addition, 56 birds were observed roosting on the Triangular Spit section in August.

The main preferred area of usage would appear to be at the western end of the site, in Ryan's Field and adjacent reaches of Lelant water, although other areas may be used on occasion. Whilst the roost flocks are generally susceptible to disturbance events, in this case, it is expected that the main roost site would be some distance from the works. However, hard weather movements might potentially increase site usage, and so consideration will need to be given to ensuring the provision of adequate 'undisturbed' areas within the site during the construction period.

2.2.10 GREY PLOVER

A wader often found in more sandier estuaries and coastal locations during the winter and on passage, and usually in fewer numbers than the Golden Plover. However, unlike the Golden Plover, the species predominantly feeds on the intertidal zone around low water, with denser roost flocks occurring around high water. After a period of increase at a national level, the species has undergone a decline in recent years.

The 2000/1 programme regularly recorded the species on the site in numbers of between 25 and 45 birds during the winter months, with roosting numbers slightly higher than feeding maxima. They were identified as one of the few species feeding on the intertidal areas of Carnsew Pool, although the majority of birds were recorded feeding on Lelant Water. The western end of this site (Lelant Saltings) were the main roost for the species, although Copperhouse Pool was used to a lesser extent.

Interestingly, the western end of Carnsew Pool was identified as the key feeding and roosting site for the species at low water from the 2004/5 programme, with up to 24 birds feeding in the zone, whilst the zones immediately adjacent to the Pool also used on occasion (Figure 10). The western end of Lelant Water was not identified as a key feeding area from the programme. The Estuary Mouth section was also recorded as a roost around low water on one occasion, and in general, usage on the system was recorded from December through to March. Around high water, Carnsew Pool continued to be an important feeding resource (at the western end of the site) with up to 22 birds using the sector in February, with some feeding also on the Lelant Causeway section. Roosting activity around high water was concentrated on the Triangular Spit section, with flocks present from December to March, and a peak of 23 birds in January. In this month a roost flock of 18 birds was also recorded on the Lelant Saltings, the only roost record for the site from the programme.

The apparent shift in usage from the western end of Lelant Water to Carnsew Pool is of note and suggests some change in invertebrate prey, sediment conditions or vegetative cover. As with most species, usage on Carnsew was at the western end, where an intertidal mud/sand flat habitat is available. The use of the Triangular Spit section as a roost is also of note, parts of this sandy area remaining uncovered on most tides. The Hayle complex is not of national importance for the species, and flocks might be considered of regional importance. The usage of the Triangular Spit area as well as Carnsew means that flocks, including roosting activity is relatively close to the main development area, and will require consideration in terms of disturbance minimisation during construction.

2.2.11 LAPWING

As with Golden Plover, the Lapwing tends to often feed on inland locations, moving to estuaries to roost, and as they have similar habitat and prey preferences, the species are often found adjacent to each other on estuarine sites. Numbers on estuaries tend therefore to be quite variable, both between years and within seasons, with take-up of estuarine sites depending on the availability of adjacent inland feeding resources and weather conditions. In periods of hard weather, an influx of birds into the system might be expected from inland and upland areas.

Flocks of up to 1,000 were recorded from the 2000/1 programme, with peak usage recorded in January and February, although for the majority the autumn and winter smaller flocks of around 250 birds were present. Lelant Water was the favoured area, with flocks also using the upper reaches of Copperhouse Pool.

The current monitoring programme recorded a similar maxima, with a roost flock of 1,200 birds observed on the western end of Lelant Water in December (Figure 11). This area was also used as a roost at low water in January and February, whilst Ryan's Field also supported roosting flocks over the December to February period, the maximum of 759 birds recorded on this zone in December. The eastern end of Copperhouse Pool also had substantial low water roosts with a flock of 398 birds in January. Feeding activity around low water was more restricted, but with a flock of 286 birds on the western end of Lelant Water in February, and a smaller flock of 52 birds recorded on Copperhouse Pool in December. Around high water, roosting activity continued on the site between December and February, with concentrations at the western end of the site, and with flocks of up to 630 birds on Lelant Saltings, 202 on Grigg's Quay, 162 on Ryan's Field, and 366 on Lelant Causeway. In addition, a high water roost was established on Copperhouse Pool, with up to 142 birds recorded.

In terms of overall numbers and density of usage, the western end of the site on Lelant Water is the key site for Lapwing on the Hayle. However, although one of the most abundant species of waterfowl within the Hayle system, numbers in the context of the national population are relatively low with the national importance threshold at 20,000. As such, it is considered unlikely that in most instances the proposed works would have any impact upon the Lapwing population of the area, although in periods of hard weather, an influx of birds might entail flocks coming into the area in closer proximity to the main area of activity.

2.2.12 DUNLIN

A characteristic and ubiquitous wader of estuaries, the Dunlin can be found on most muddy or muddy sand habitats. Despite the relative abundance of the species, the national population has been declining in recent years. Although present throughout the winter months at most sites, the species also moves through the UK coasts during passage and can be present on estuaries in most months of the year.

The programme of 2000/1 recorded the species in most months, the greatest period of usage being between December and March, with a peak of over 500 birds but more usually flocks of around 250 recorded. Clear secondary smaller peaks were evident at the site during April/May and August/September with passage flocks moving through the site at this time. The autumn movement is larger than that of the spring probably reflecting the presence of first year birds moving through following the adult movement. However Dunlin migration is complex, with several different races moving along UK coasts at different times, to and from various breeding grounds, and with adult and juvenile movements further complicating patterns during the autumn. The majority of birds were feeding on Lelant Water, but with smaller flocks using Carnsew Pool and Copperhouse Pool. In addition, Ryan's Field was used at high water, together with Lelant Saltings.

The 2004/5 programme recorded similar numbers, but with concentrations feeding on the western end of Carnsew Pool during January to March (peak of 450 birds in February), and in September, with further flocks feeding on the section between Lelant village and Carnsew Pool (peak of 75 birds in March) (Figure 12). By contrast, feeding activity on the western end of Lelant Water (the area identified as being of key importance for the species in 2000/1) supported a peak of 34 birds (March). Roosting activity at low water was concentrated on the Lelant Causeway section, with flocks present between December to March inclusive, with a peak of 217 birds recorded. In addition, Carnsew Pool and the outer estuary also featured roosting flocks at this time, but on an infrequent basis. In general, the greatest density of usage at low water was on the western end of Carnsew Pool, with the section between Lelant village and Carnsew and the outer estuary also featuring relatively high densities. Lelant Saltings were often a key feeding area at high water, with flocks of up to 363 birds recorded (February), with Lelant Causeway, Carnsew Pool and Copperhouse Pool also supporting feeding flocks around high water during several months of the winter, and the Triangular Spit in September. High water roosts were recorded primarily on The Triangular Spit, but with Lelant Causeway and Lelant Saltings also regularly used.

As with several other wader species, it would appear that there has been a shift in feeding activity within the site from the 2000/1 survey programme, with a reduction in activity on the western extent of Lelant Water and an increase in activity on Carnsew Pool and the section between Lelant village and Carnsew. This would perhaps reflect a change in prey/feeding conditions, perhaps reflecting a gradual silting and algal coverage of upper system areas, and a corresponding shift of preferential feeding conditions into the middle part of the estuary. In general, the majority of Dunlin activity is on the periphery of the key development sites, and as such, consideration will be required to minimise disturbance impacts to feeding and roosting birds during the winter periods.

2.2.13 BAR-TAILED GODWIT

The Bar-tailed Godwit is another primarily estuarine wader, with feeding preferences for more sandier mudflats and a high mobility in response to changing substratum characteristics. In recent years the species has been in decline at a national level, with numbers decreasing primarily on the west coast.

Overall numbers in the region of 10 birds were recorded over the winter months of the 2000/1 programme, but with peaks of around 20 birds during passage in September. Copperhouse Pool was particularly important for the species at low water, but with flocks from around the site moving onto Lelant Saltings to roost at high water.

Small numbers were recorded during the 2004/5 programme with flocks of up to 6 birds on Carnsew Pool (western end) in January and 4 birds on the adjacent section between Lelant village and Carnsew in February (Figure 13). 5 birds were using western Lelant Water to roost at low water in January, with 3 roosting birds on the Lelant village to Carnsew section in March. However usage was generally concentrated in these areas and during January to March, with no passage or early winter build-up observed at the site. Copperhouse Pool and Lelant Water were little used and the greatest density of usage was observed from Carnsew Pool and the adjacent section of outer Lelant Water. Roosting activity was concentrated on the Lelant Saltings with 5 or 6 birds present during January to March, but in general, roosting activity at high water was low.

Again there appears to have been a reduction in the importance of the Lelant Water and Copperhouse areas, with Carnsew Pool becoming more important for feeding activity. Whether the shift in usage reflects a deterioration in feeding habitat on Lelant in particular, or an increase in available food (and perhaps increased intertidal area) in Carnsew Pool is unclear. The small number of birds using the site means that the system is of limited importance for the species in the context of the region, and given the low level of usage, the status of the species should not be detrimentally impacted by the proposed works.

2.2.14 CURLEW

The Curlew is another characteristic species of muddy sand estuaries, although feeding can also be undertaken at inland sites, with flocks moving onto and off the estuarine system depending on time of year, weather, tide and crop conditions. The species has been stable in recent years at a national level.

The 2000/1 programme recorded usage by the species in most months, with around 100 birds present, and the peak maxima occurring in the late winter at over 350 birds. However a high degree of variation in numbers was noted, with many birds primarily feeding on inland pasture, moving onto the estuary to roost when disturbed from fields. Lelant Water was the main area of usage, with Ryan's Field used as a high water roost in addition to Lelant Saltings.

The 2004/5 programme recorded a similar pattern of usage (Figure 14), with feeding at low water primarily carried out on the western end of Lelant Water with up to 31 birds feeding on this area in February, but with up to 191 birds roosting at low water in the same area in January. Substantial low water roost flocks were observed on Lelant water in most months (December through to March and June through to September). Ryan's Field was also used occasionally as a low water roost, with 126 birds using the area in July. However at high water Lelant Saltings were of key importance for the species, with flocks present in most months and a peak of 204 birds on the section in December (mean of 115 birds over the year). Ryan's Field was also of increased importance with flocks of up to 156 birds using it. Limited feeding activity was also carried out over high water, with most areas having some birds but with greatest numbers (up to 15) on Copperhouse Pool.

The Curlew is present on the system in reasonably high numbers for much of the year, with the majority of birds roosting on the sections to the west of the Hayle system with usage linked to inland feeding availability. It is interesting that for this species, there was a correlation of key usage areas between 2000/1 and 2004/5, however this was largely for roosting activity rather than for feeding. Despite the relatively consistently large flocks using the system, numbers are well below the national importance threshold, although the population is considered to be of regional significance. The relatively large distance of the main feeding and roosting areas from the proposed development suggest that development activity would not have a measurable impact on the status of the population in the estuary.

2.2.15 REDSHANK

Another ubiquitous species of estuaries and wetlands, the Redshank population has remained relatively stable over recent years. However, as the species tends to feed on *Corophium volutator* and other invertebrates on the upper shore in many areas, it is often more susceptible to hard weather mortality events than other estuarine species, with invertebrates retreating down through the mud in cold weather and the upper surface often freezing during neap tide periods.

The 2000/1 programme recorded a wintering population of around 40 to 50 birds although with considerable variation in maxima. Usage remained high from November to March, with numbers building again in July with return passage. High water usage was slightly higher than low water, although this is often the case for the species, as individuals feeding in the bases of creeks are often missed at low water, but pushed out around high water. The species was well distributed across the site at low water, but with a concentration on Copperhouse Pool. At high water Copperhouse birds roosted at the eastern end of the section, with Lelant birds moving onto Lelant Saltings or Ryan's Field.

The 2004/5 programme also recorded a relatively high level of usage on Copperhouse Pool at low water with around 20 to 30 birds regularly feeding on the reach (Figure 15), with Carnsew Pool again of importance with up to 32 birds on the western section in December and flocks present during the winter. The western end of Lelant Water supported between 10 and 20 birds for much of the year, with Ryan's Field supporting up to 18 feeding birds at low water. Western Lelant also supported a flock of 34 roosting Redshank in December, and the majority of the Lelant and Copperhouse sections supported a density of between 10 and 20 birds per km², with the middle Copperhouse and Carnsew key areas at 50 to 60 birds per km². At high water, roosts were regularly established on Lelant Saltings, Ryan's Field and upper Copperhouse Pool, with flocks of up to 48 birds on the latter site in February. However feeding also continued around high water, with feeding activity particularly concentrated on the areas of Copperhouse Pool still uncovered by the tide, with around 30 to 35 birds feeding in this area over the winter. Lelant Saltings also supported a feeding population of up to 34 birds but in general usage on this zone was less numerous.

In general therefore, patterns of usage were broadly similar between the two programmes, with the species well distributed around the site at low water and with concentrations on available upper shore mud at high water. Redshank are present at the site in numbers characteristic of an estuarine habitat, and as such the site is of local importance. The species can to some extent habituate to disturbance activity, and is often found relatively close to human activity, given its preferred feeding locations on the upper shore and within creek systems. As such, it is not considered to be of particular risk to impact during the proposed works, although during hard weather periods, the potential for wider mortality risk would increase.

2.2.16 LITTLE EGRET

The Little Egret has undergone a population and range expansion in recent years, and is now a regular component of the avian assemblage in many south-western estuaries of the UK throughout the year. The dynamic nature of the population means that importance thresholds for site populations are difficult to quantify and changing rapidly. The Hayle estuary has been considered of national importance for the species over a number of years, with a notional threshold of 10 birds used for this assessment (e.g. WeBS 2001-3 reported in Cranswick *et al*, 2005). However, in the most recent published WeBS data (WeBS 2004/5 reported in Banks *et al*, 2006), the Hayle Estuary is no longer considered to be of national importance for the species, the qualifying level for national importance having been raised to 30 birds to reflect its change in population in recent years. It is however considered prudent, given the notional threshold level and the dynamic nature of the population, that the Hayle system still be considered to be potentially of national importance for the species for the purposes of this report and the associated Environmental Assessment.

The 2000/1 programme recorded the species in all months but with the main period of usage between July and October when around a monthly maxima of 20 birds was recorded. For the winter this declined to a level of between 5 and 10 birds. At low water birds were evenly distributed throughout the system, feeding in creeks and shallows, but with a high water concentration at the western end of Lelant Water, with smaller numbers using Carnsew and Copperhouse Pools as well as Lelant Causeway.

The current monitoring period recorded similar numbers in general, with, at low water, birds evenly distributed around the site, but with slightly greater densities (10-20 birds per km²) in the Western Copperhouse and Inner Harbour sections and lower usage in Carnsew Pool (Figure 16). Between 3 to 5 feeding birds were recorded in the main Lelant sections on a number of occasions, with 2 to 3 birds in Copperhouse. Usage was generally similar over most of the year. Roosting activity at low water was observed on Lelant Water (up to 5 birds) in most months. High water roost activity was largely concentrated on the Lelant Saltings with up to 13 birds recorded in August, but with limited feeding activity around the site as a whole at high water.

In general, the species is evenly distributed in small numbers across the site, but with a greater density of usage in the Inner Harbour and western Copperhouse area, although this is generally only for 1 to 3 birds per section. Given the proximity of these sites to the proposed works, there is therefore the potential for disturbance to occur, although this would be of limited extent given the number of birds using the areas, and the existing levels of noise and activity, and associated habituation by individuals within their preferred feeding ranges. Roost concentrations are located some distance from the proposed development at the western end of the system. Disturbance impacts are therefore likely, but on a localised and contained scale, although it is acknowledged that the Little Egret is one of the more important species using the Hayle, given that the site is potentially of national importance for it. As such, it will be necessary to further investigate in the following sections, the potential for impacts to the species from the proposed development.

3. DISTURBANCE

The following text has been included to both provide an overview of the existing disturbance types and levels around the Hayle system, as well as the impacts to avifauna and site function from the disturbance stimuli, together with a brief review of research into disturbance impacts to avifauna from a variety of activities.

3.1 Disturbance Impacts - Background

As a rule, ingress of personnel onto a normally undisturbed intertidal habitats or saltmarsh creates the greatest disturbance effect, with the long-term operation of a plant immediately inland of the intertidal zone for instance on or immediately behind a bank (and without the presence of personnel external to the plant) having the least effect. Ingress onto a normally undisturbed intertidal zone or saltmarsh by personnel can cause some feeding species to fly at a distance of over 300m, but with most moving off at around 100m to 200m, and some, such as the Oystercatcher and Turnstone are tolerant of approaches to within 50m to 75m. In areas of extensive intertidal habitat, resettlement is often relatively rapid, and further along or down shore. However, although this may not therefore be of particular significance in terms of direct energy budget implications, it may be that flocks are pushed onto sub-optimal feeding areas, whilst similarly, an increase in predation (in combination with existing feeding activity) may also occur, both factors being of key significance if the disturbance effect were to be maintained over a protracted period. However, the flight response of feeding birds does appear to have a series of variables attached to it, most of which cannot be readily ascribed to clearly identifiable factors. Some feeding waders appear to be more tolerant of approach when feeding either side of high water either initially on ebb phases or latterly of the flood. This may reflect an increased tolerance to disturbance stimuli if prey availability is greater, or if they have been roosting, intake requirements being more important. Often feeding species such as Dunlin and Redshank can approach ongoing plant operation to well within 50m (much closer than an allowed approach distance by a third party), although often this approach is in a cyclical manner, i.e. with a close approach followed by a spook back down or along shore, and then with a further movement back towards the activity, followed by a further spook away etc. However, a single occurrence of small scale construction work can have an proportionally greater impact in terms of flight response to that of more large scale operations.

Disturbance responses from high water roost sites have been found to be far more variable than for feeding flocks, depending on a series of parameters apparently including topography, extent and species. For the most part, approach distances appear to be reduced, but given the usual location on the upper shore, such areas are prone to a greater frequency of disturbance. Depending on the extent of the roost site (for instance a large saltmarsh), disturbance impacts have been seen to be relatively low for single short-term activity, with flocks resettling elsewhere in the area. However, if the potential roost area is of limited size, then activity may well lead to the movement of flocks out of the area. If this continues over a couple of consecutive tides, then there is often a period of several days after the cessation of activity until the site is recolonised again. Third party disturbance events are frequently of greater impact than those of ongoing construction work, with the overflight by aircraft often having a significant 'one-off' effect, putting flocks to flight and with low speed light aircraft appearing to have a greater impact than military and commercial jets. In addition, irregular but frequent activity such as dog walking and

bird watching on the upper shore can have the effect of excluding bird usage from an area of habitat, this being particularly important on high water roost areas.

Research into responses to noise suggests that at levels in excess of 84dB(A) there is a flight response in waterfowl, whilst below 55dB(A) there is no effect, although for levels between 43dB(A) and 87dB(A), the results are less clear, but with ultimately no effect on levels of diversity recorded (Smit & Visser, 1993), whilst very high sound levels, occasional noise and variable noise levels can elicit a greater response in feeding waterfowl than more regular noise generation, particularly if accompanied by a visual stimuli. However, habituation can occur to regular noise and or visual stimuli, particularly in birds that have remained in an area for sometime i.e. over-wintering.

In general, research into responses to noise impacts on avifauna suggests that at levels in excess of 84dB(A) there is a flight response in waterfowl, whilst below 55dB(A) there is no effect, although for levels between 43dB(A) and 87dB(A), the results are less clear, but with ultimately no effect on levels of diversity recorded (Smit & Visser, 1993), whilst very high sound levels, occasional noise and variable noise levels can elicit a greater response in feeding waterfowl than more regular noise generation, particularly if accompanied by a visual stimuli. However, habituation can occur to regular noise and or visual stimuli, particularly in birds that have remained in an area for sometime i.e. over-wintering.

3.2 Observed Disturbance Responses

The initial 2000 to 2001 ornithological survey programme (Evans *et al*, 2002), recorded disturbance to avifauna as generally light, caused by helicopters, raptors, bait digging and dog walkers. Dog walking tended to have a localised impact whereas raptor based disturbance events and those from aircraft affected the majority of the estuary. Significant disturbance from dog walking occurred around Lelant and Carnsew, and as this activity was curtailed due to access restrictions resulting from the foot and mouth outbreak, it was considered that this level of disturbance was an underestimation. Indeed, roosting activity by Ringed Plover increased on Carnsew during the closure of the adjacent footpath, although this pattern was not seen across other species of the assemblage and did not affect Little Grebe usage on Carnsew. The report concluded that wader roost function in Carnsew and the Triangular Spit is influenced by disturbance largely resulting from dog walking activity, but that feeding activity in Carnsew was not significantly affected.

During the 2004 to 2005 survey programme the responses of avifauna to a number of external stimuli were recorded, with a numerical magnitude association used to classify response i.e. whether the response was behavioural such as cessation of feeding, or involved a movement response either walking away from the point of the stimuli or put to flight etc.

Disturbance sources were grouped under a series of headings including Dog Walking, Vehicles, Land-based Leisure and Avian Predator (Figure 17).

Dog walking was primarily concentrated around Carnsew, the Triangular Spit and the outer estuary, with the most substantial responses by avifauna noted around Carnsew and the Triangular Spit, the outer estuary and Copperhouse, with flight out of sight or out of the estuary recorded at these locations.

Disturbance from vehicles occurred around the estuary, but with the greatest response in Lelant Water/Ryan's Field adjacent to the causeway.

Land-based Leisure was also dispersed across the site but with a concentration in this area, with the greatest response in Lelant Water/Ryan's Field and the area adjacent to Carnsew.

Avian predation activity was concentrated on Lelant Saltings, as well as on Copperhouse, a distribution not unexpected given wader usage on the site. Avifaunal responses tended to be greatest in these areas.

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