Identification of Wintering Wildfowl High Tide Roosts & Recreational Disturbance Impacts on the Taw Torridge Estuary

The Skern wader and wildfowl roost gathers on the flooding tide with an angler on Grey Sand Hill

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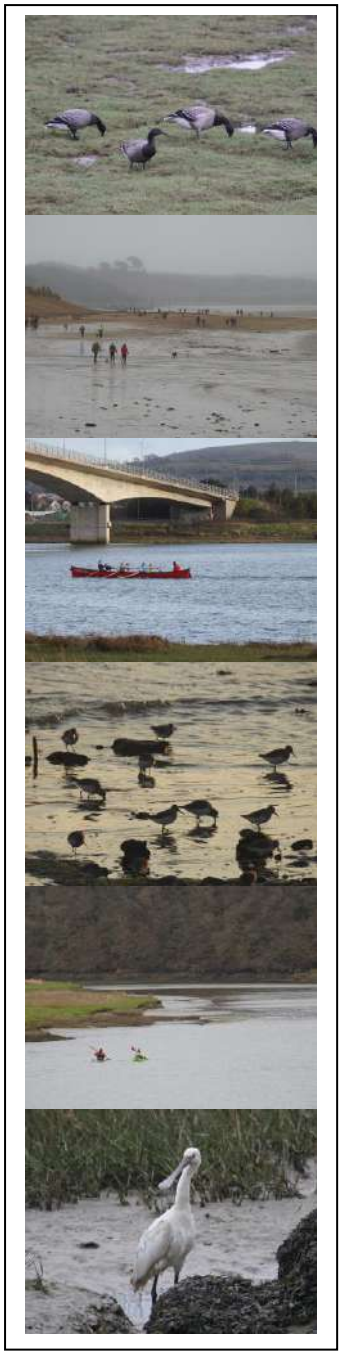

Final Report

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Executive Summary

I. A comprehensive review of the current and historical wintering waterbird populations and distribution on the Taw Torridge estuary was undertaken. Data acquired over forty years of monitoring show that bird populations on the estuary have suffered serious declines and that the distribution of birds over the estuary is influenced by levels of access for recreational activity.

II. High tide roost locations used by wintering waterbirds were identified and fully described through engagement of The Wetland Bird Survey (WeBS) team and field observations. Twenty-one significant and consistent high tide roosts were identified, with most being distributed around the estuary mouth and lower reaches of the River Taw. High tide roosts can occur at sites subject to intense levels recreational activity, although they are generally located in specific areas of restricted access for recreational activity.

III. A baseline of recreational activity at the Taw Torridge estuary in the winter period was defined through interviews and engagement of estuary experts and users, online and field surveys, and direct observation. Although a wide range of activities were identified and observed, most were very rarely encountered. Walking and dog walking were identified as the most frequently occurring activities with most participants being of local origin and making frequent visits to the estuary.

IV. Surveys to assess the effects of recreational activity on wintering birds at the Taw Torridge estuary were undertaken from October 2018 to March 2019. Walkers accompanied by dogs off the lead were identified as the dominant cause of disturbance to wintering waterbirds at the estuary. Increasing levels of access to the estuary for recreational activity were found to negatively impact the numbers of waterbirds present.

V. Roosting and feeding waterbirds of all frequently occurring species were routinely observed being disturbed across the estuary. Disturbance events were observed across a range of habitat including the offshore, intertidal and terrestrial zones. A range of responses on an escalating scale, from becoming alert to evacuating the area were recorded and described. The most frequently observed response to disturbance overall was a ‘major flight’ of over fifty metres.

VI. The frequency and intensity of disturbance to wintering waterbirds at the sites observed on the Taw Torridge estuary appears to be comparable or even higher than

that reported from other estuaries where disturbance has been identified as an issue thought to be potentially detrimental to waterbird populations.

VII. The Taw Torridge estuary was found to be lacking in terms of conservation-based management for the benefit of the wintering waterbird assemblage, despite its acknowledged importance. As a result, this report provides a range of management and mitigation proposals including the provision of signage, guidance, published material, on-site staffing, and the creation of protected areas.

VIII. The project instigated what is seen to be the first step in tackling the issue of disturbance from recreational activity on the Taw Torridge estuary by hosting a workshop event, attended by stakeholders and user groups to present early findings and stimulate an ongoing discussion around potential conflicts between recreational activity and wildlife at the estuary.

IX. **Disclaimer:** references to 'no disturbance' of birds in reality mean 'no apparent disturbance', as we are not measuring the internal state of birds, just the behaviours that are visible to human observers. (refer to paragraphs 1.1.18 and 5.2.2).

1 Introduction

1.1 Study area and project background

1.1.1 The Taw Torridge Estuary (TTE hereafter) is an extensive estuary of approximately 1,300 ha in Northern Devon (Figure 1). The estuary is a major geographical feature within the area, with the sub-regional centre of Barnstaple being situated on the eastern reaches of the River Taw and the important market and port town of Bideford to the south on the River Torridge.

1.1.2 A number of other towns and villages are located in close proximity to the estuary, notably Braunton, Fremington, Yelland, Instow and Appledore. The estuary is a historical and ongoing focal point for commercial and residential development in a region where land use is predominantly agricultural.

Figure 1. Aerial photograph of the Taw Torridge estuary and surrounds

1.1.3 The TTE encompasses a wide range of habitats, from beaches and dunes at the estuary mouth to extensive intertidal sandbanks, rock, mudflat and saltmarsh. The estuary is designated as a Site of Special Scientific Interest (SSSI) and notified for its intertidal habitats, rare plants, and overwintering bird populations (https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1002990.pdf, accessed 08/04/2019). With respect to the latter, nationally important numbers of overwintering (European) Golden Plover *Pluvialis apricaria*, (Northern) Lapwing *Vanellus vanellus* and (Eurasian) Curlew *Numenius arquata* alongside abundant

(Common) Redshank *Tringa totanus*, Dunlin *Calidris alpina* and (Eurasian) Oystercatcher *Haematopus ostralegus* are noted as being of particular importance.

1.1.4 As the composition of the SSSI wintering bird assemblage alters through time due to fluctuation in species populations, any native wetland bird species, which in practice includes 'waders' (a wading bird of the order Charadriiformes) and 'wildfowl' (ducks swans and geese of the order Anseriformes), will be a legitimate part of the bird assemblage (Natural England, 1998).

1.1.5 Monthly counts of waterbirds as defined by Wetlands International (Rose & Scott, 1997) are undertaken throughout the year at the TTE for the Wetland Bird Survey (WeBS). Counts are undertaken in a period of two hours either side of high tide and are designed to gather data on the abundance and distribution of non-breeding waterbirds.

1.1.6 The SSSI designation states that more than 20,000 non-breeding waterbirds may winter on the estuary, and as a consequence, the estuary was proposed for designation as an internationally important Special Protection Area (SPA). However, the site was not designated as it was claimed to not, at that time, meet the requirements of the EU Birds Directive (European Parliament, 2009).

1.1.7 Nevertheless, the estuary is an Important Bird Area (IBA) and features a Royal Society for the Protection of Birds (RSPB) reserve at Isley Marsh. The mouth of the estuary is designated within the Bideford to Foreland Point Marine Conservation Zone (MCZ), and part of this area falls under the North Devon Coast Areas of Outstanding Natural Beauty (AONB). The estuary is also classed as a 'buffer zone' for the United Nations Educational, Scientific and Cultural Organisation (UNESCO) North Devon Biosphere Reserve, the core area of which is the Special Area of Conservation (SAC) at Braunton Burrows.

1.1.8 The TTE was the first in the country to adopt an Estuary Management Plan (EMP), which guides the use of the estuary for commerce, recreation and nature conservation. The most recent Taw Torridge Estuary Management Plan (2010-2015) had as its first aim "To reverse the decline in biodiversity" and stated that "The main concern around the Taw Torridge Estuary relates to the disturbance to wildlife".

1.1.9 The North Devon and Torridge Local Plan (2011-2031) was adopted in October 2018 and requires 20,175 new homes to be built within this timeframe. A significant proportion of these houses will be close to, and offer ready access to, the TTE as this is where the majority of the existing population is located. The resulting increased population will invariably generate a commensurate increase in demand for recreational activity within and adjacent to the estuary.

1.1.10 The project partners accept that any initiatives to reconcile this growth and development with the conservation of wintering waterbird populations should be based on an objective understanding of the causes of disturbance and its effects and consequences (impacts) upon these bird populations. This study was therefore commissioned to acquire comprehensive and relevant baseline data that

can be utilised for the assessment of planning applications, estuary management, and potentially in mitigation schemes.

1.1.11 After a competitive tender process ECON Ecological Consultancy Ltd (hereafter, ECON) was commissioned to undertake the work over the October 2018 to March 2019 winter period.

Recreation and conservation

1.1.12 It is well known that countryside access can bring considerable benefits through a range of mechanisms to the local economy (Bateman and others, 2014) and people's physical health and mental wellbeing (Pretty and others, 2005).

1.1.13 Recreational activities on the TTE undoubtedly bestow these benefits upon the local community. However, with increasing levels of access and a growing population, there is the potential for significant conflict with nature conservation objectives.

Disturbance of birds

1.1.14 Disturbance, in this context, was defined by Fox & Masden (1997) as "Any human-induced activity that constitutes a stimulus (equivalent to a predation threat) sufficient to disrupt normal activities and/or distribution of waterbirds relative to the situation in the absence of that activity."

1.1.15 It is important to differentiate between the effects and impacts of disturbance. In brief, a disturbance effect is an observable response, such as taking flight. A disturbance impact relates to reductions in condition, productivity or survival embraced in the concept of individual fitness, which are much more difficult to quantify (Robinson & Pollit, 2002) and to prove a causal link with disturbance effects.

1.1.16 Disturbance impacts may be highly variable according to circumstance, further obscuring the detection of them. For example, birds may only be susceptible at certain times or under particular, and variable conditions such as weather (Goss-Custard and others, 2006).

1.1.17 There is an overwhelming wealth of published literature on the disturbance of birds, much of which has come about as a result of conflict between human activity and protected areas. Davidson & Rothwell (1993) provide a useful overview of disturbance to waterbirds on estuaries.

1.1.18 A wide range of anthropogenic activities have been shown to elicit a disturbance response in birds, including air traffic (Drewitt 1999), dog walking (Banks & Bryant, 2007) and construction works (Burton and others, 2002). Ross & Liley (2014) provided the following summary of resulting impacts of disturbance to wintering and passage waterbirds;

- A reduction in the time spent feeding due to repeated flushing/increased vigilance (Fitzpatrick & Bouchez, 1998; Stillman & Goss-Custard, 2002; Bright and others, 2003; Thomas and others, 2003; Yasué, 2005).

- Increased energetic costs (Stock & Hofeditz, 1997; Nolet and others, 2002) due to birds taking flight, changing behaviour etc.
- Avoidance of areas of otherwise suitable habitat, potentially using poorer quality feeding or roosting sites instead (Cryer and others 1987; Gill 1996; Burton and others, 2002a; Burton and others, 2002b).
- Increased stress (Regel & Putz, 1997; Weimerskirch and others, 2002; Walker and others, 2006; Thiel and others, 2011).

1.1.19 Birds may also be subject to disturbance from non-human sources such as predators, but it is possible that human disturbance may be more severe. For example, waterbird numbers have been found to recover very shortly after disturbance from a hunting raptor (Kirby and others, 1993) yet may take several weeks to recover after disturbance from shooting (Fox & Madsen, 1997).

1.1.20 Although it is understandably difficult to ascertain the true cost of disturbance to waterbirds at a local, national, or international level, especially against a backdrop of widespread habitat loss, climate change and many other confounding factors, it is widely accepted that human disturbance is a legitimate threat to the UK's wintering waterbird populations.

1.1.21 Furthermore, it could be argued that localised disturbance to birds at wintering grounds within and adjacent to designated protected areas in the UK can be a relatively easy issue to manage and mitigate when compared with more complex and widespread or even global issues.

1.2 Project aims and overview

1.2.1 The overarching aims of the project were to identify wintering waterbird high tide roosts and the effects of disturbance arising from recreational activity on wintering waterbirds at the TTE SSSI.

1.2.2 To achieve this, the project primarily aimed to provide:

- Evidence of the location and nature of wintering waterbird high tide roosts, the bird assemblages associated with these roosts and the relative size and importance of the roost sites to feature species of the TTE SSSI.
- Detail on the causes of bird disturbance, assessment of the significance and intensity of these disturbances, and the subsequent effects of any disturbance on the birds using the estuary.
- Advice on potential management and mitigation measures to address disturbance effects and impacts.

1.2.3 The multi-faceted nature of this project required a suite of methodologies to be simultaneously implemented to address each of the research questions and meet the aims and objectives of the project. In brief, ECON have looked to meet the project aims through a combination of desk-based study, volunteer and estuary user engagement and interviews, and fieldwork.

1.2.4 Local place names, as used on the relevant 1:25,000 scale Ordnance Survey mapping, are used throughout this report and reference to the map is recommended to aid comprehension.

1.2.5 The project findings are detailed and presented in the following sections;

- 2. Wintering bird populations and their distribution.
- 3. Identification of high tide roosts.
- 4. Recreational disturbance impacts.

2 Wintering bird populations and their distribution

2.1 Aims and methodology

2.1.1 In order to understand disturbance effects and potential impacts on wintering birds and identify future risks in an estuary planning and management context, it was necessary to understand the populations and distribution of wintering birds at the TTE. To that end, this section of the report aimed to:

- Collate and analyse existing data on relevant wintering wetland bird populations and their distribution.
- Identify the broad proportional use of the TTE by birds at a species level.
- Identify areas of importance for roosting at high tide and feeding at low tide.

2.1.2 To achieve these aims a comprehensive review, analysis and presentation of all available wetland bird survey (WeBS) data was undertaken. Supporting anecdotal evidence was gathered from discussions and interviews with the WeBS counters and other estuary experts.

2.2 Historical population trends

2.2.1 The TTE has a long history of bird recording, with National Wildfowl Counts (NWC) dating back to 1965. Counts of waders were also conducted from 1969, when the Birds of Estuaries Enquiry (BOEE) started, although coverage appears to be limited or highly variable until the winter of 1972-73.

2.2.2 Coverage of the estuary downstream of the 'old' bridges at Bideford and Barnstaple is thought to have been relatively consistent since at least 1975 (Tim Davies, North Devon WeBS co-ordinator, *pers. comm*).

2.2.3 A number of historical changes in coverage and methodology up to the present day influence the count data but are not thought to have been significant enough to have had a detrimental impact on the reporting of broader estuary trends undertaken here. For example, (Great) Cormorant *Phalacrocorax carbo* was not recorded until the winter of 1987, and (Common) Kingfisher *Alcedo atthis* was not recorded until 1994; this being one of a number of species added once the NWC and BOEE were fully integrated into Wetland and Estuary Bird Survey (WeBS) counts by the British Trust for Ornithology (BTO) in 1993 (see

https://www.bto.org/volunteer-surveys/webs/about/history-webs, accessed 20/1/18).

2.2.4 The BTO hold and maintain a database to provide historical whole estuary counts of waterbirds on the TTE, aggregated from all available data sources and taking the variation of coverage into account.

2.2.5 At the time of writing, the whole estuary count database has not been updated to reflect data gathered in the 2017-2018 winter period, although this data has been obtained for each individual sector.

2.2.6 To provide a concise, relevant, and useful historical perspective (Figure 2) of wintering water bird populations on the estuary the following filters were applied:

- Data prior to the winter of 1972-73 was excluded as a result of being incomplete. Data was then filtered for the October to March period of interest and aggregated into winter periods.
- Data was screened for any obvious anomalies. A record in February 2014 relating to 2,200 (Common) Goldeneye *Bucephala clangula* was excluded as being anomalous as only very small numbers (1-12) tend to occur.
- Records of all introduced, escaped, domestic and vagrant species were excluded. Very occasional species (<10 records in the 1972-2017 period) were also excluded.
- The mean of the maximum monthly total counts from each year (October to March inclusive), and the maximum (peak) total count from all months and in all years were calculated for five-year periods.

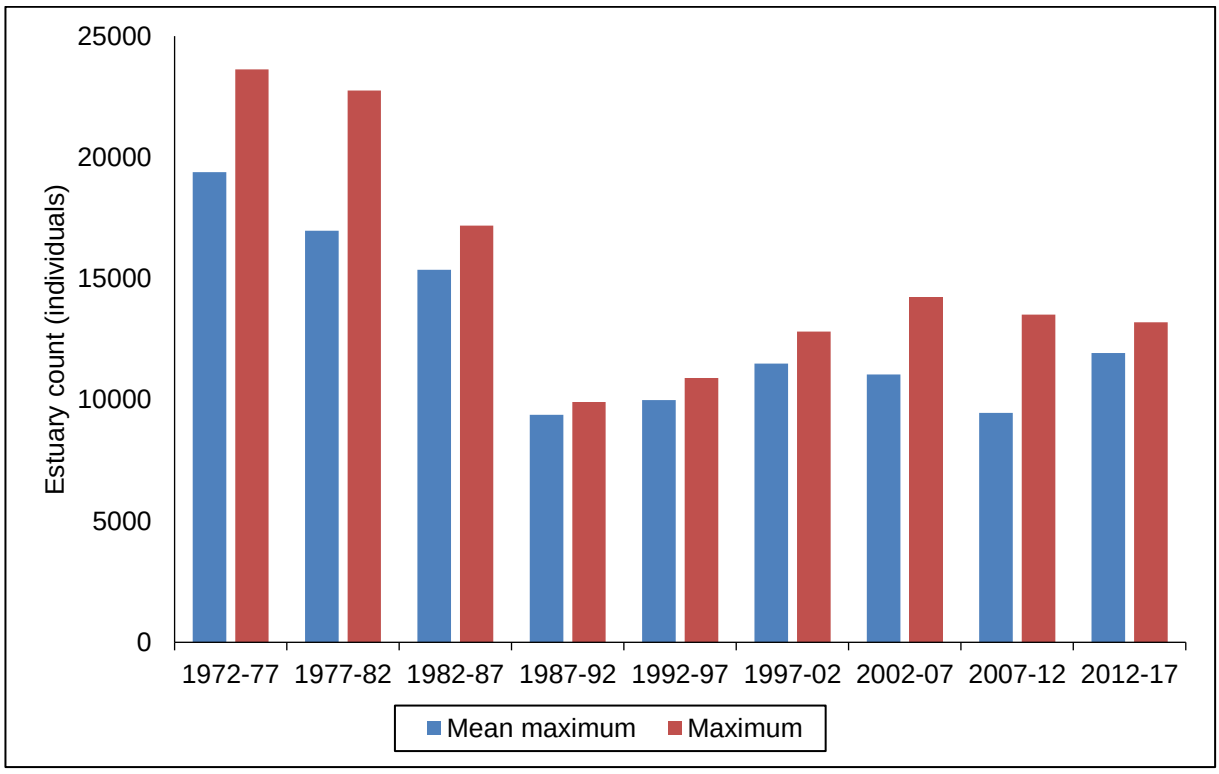

Figure 2. Five-year monthly mean maximum and five-year maximum (peak) estuary counts of all filtered WeBS species in the October to March period from 1972 to 2017 inclusive

2.2.7 The SSSI designation refers to the TTE's ability to host over 20,000 wintering waterbirds, although such numbers have not been observed since the 1977-82 period (Figure 2). Currently, mean maximum counts and maximum (peak) counts suggest around 11935 and 13196 respectively, utilise the estuary, around 61.5% and 55.9% of the maxima recorded in the reporting period in the five-year period of 1972-1977.

2.2.8 SSSI health checks carried out by Natural England state that declines of Curlew and Lapwing are in line with national population trends, rather than indicating an issue at the estuary level. Regardless of the cause(s), the total population of birds within wintering bird assemblage is clearly much reduced.

2.2.9 Although a steady decline is apparent overall, there has been some recovery since the 1987-92 period when a peak estuary count of just 9,910 birds was recorded. However, this recovery appears to have halted somewhat in recent years following a peak count of 14,245 in 2002-07 with the most recent maximum monthly counts in 2007-12 and 2012-17 of 13,517 and 13,196 respectively showing an apparently stable situation in terms of peak estuary usage over the last decade (Figure 2).

2.2.10 Consideration of the most numerous waders on the estuary indicates that the total wintering waterbird population on the TTE is primarily driven by the numbers of Lapwing and Golden Plover present. A similar pattern is suggested by both peak counts from five-year periods (Figure 3) and five-year mean monthly values (Figure 4).

2.2.11 A peak maximum count of 12,261 Lapwing in the 1972-77 period represented >50% of the corresponding maximum estuary count of 23,624 wintering birds of all species combined in the same period (Figure 3). Significantly lower peak monthly counts of 9,078 and 8,930 Lapwing followed in 1977-82 and 1982-87 respectively.

2.2.12 Following a ten-year period of relative stability from 1977 to 1987, the wintering Lapwing population on the TTE then appeared to crash, with a peak count of just 3,367 birds by 1992-97. Although numbers increased in the following years, a peak of 7,013 in 2002-07 was a long way from a full recovery to the initial population. In recent years, peak counts have again fallen, with an all-time low peak count of 3,124 in the 2007-12 period, with this increasing only to 4,622 in 2012-17.

2.2.13 The decline in numbers of wintering Lapwing on the TTE has triggered 'high alert' status due to wintering population declines of >50% over the short (5-year) and medium (10-year) term (Cook and others, 2013).

2.2.14 By contrast, the maximum count of Golden Plover of 6,000 was achieved in the 2002-7 period, of a similar magnitude to the numbers recorded in 1982-87 with a peak count of 5,950 (Figure 3). In general, the wintering population of Golden Plover appears to be highly variable, but not necessarily one of decline (Figure 4).

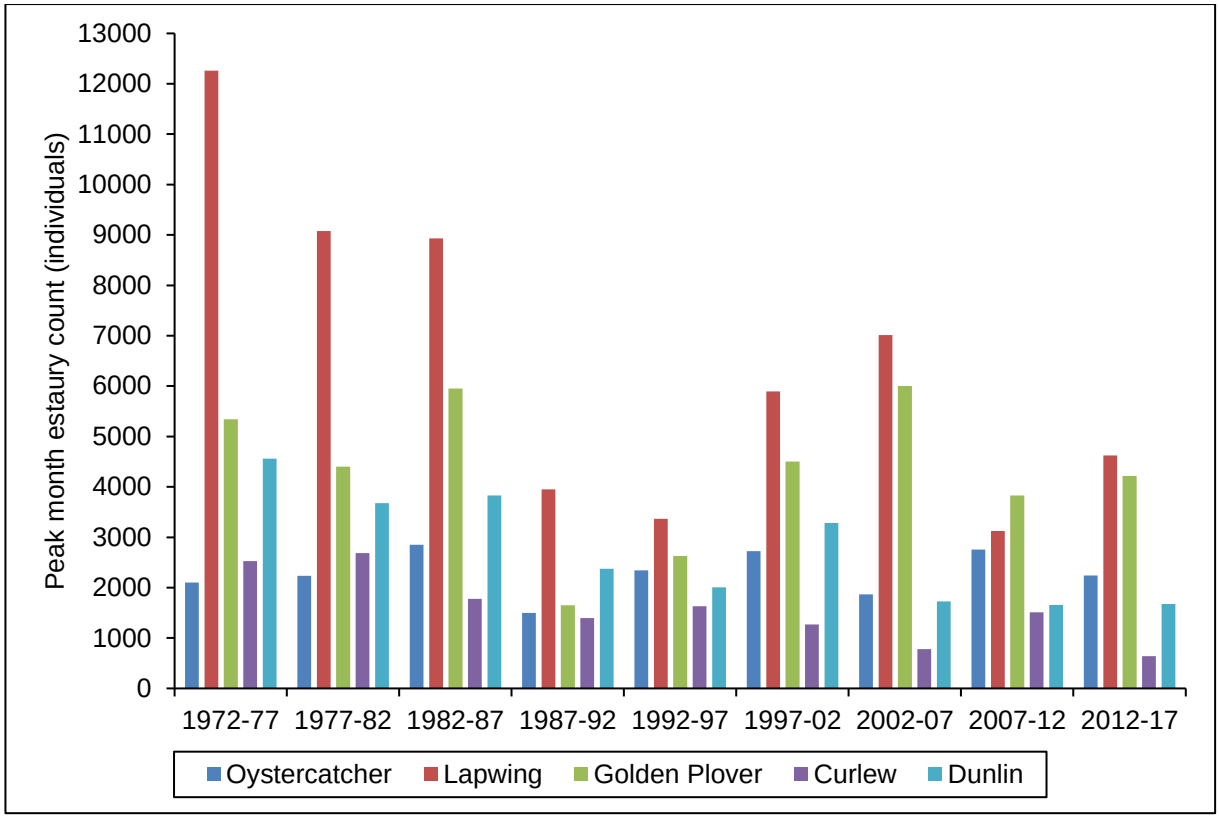

Figure 3. Five-year peak monthly counts of key wader species in the October to March period from 1972 to 2017 inclusive

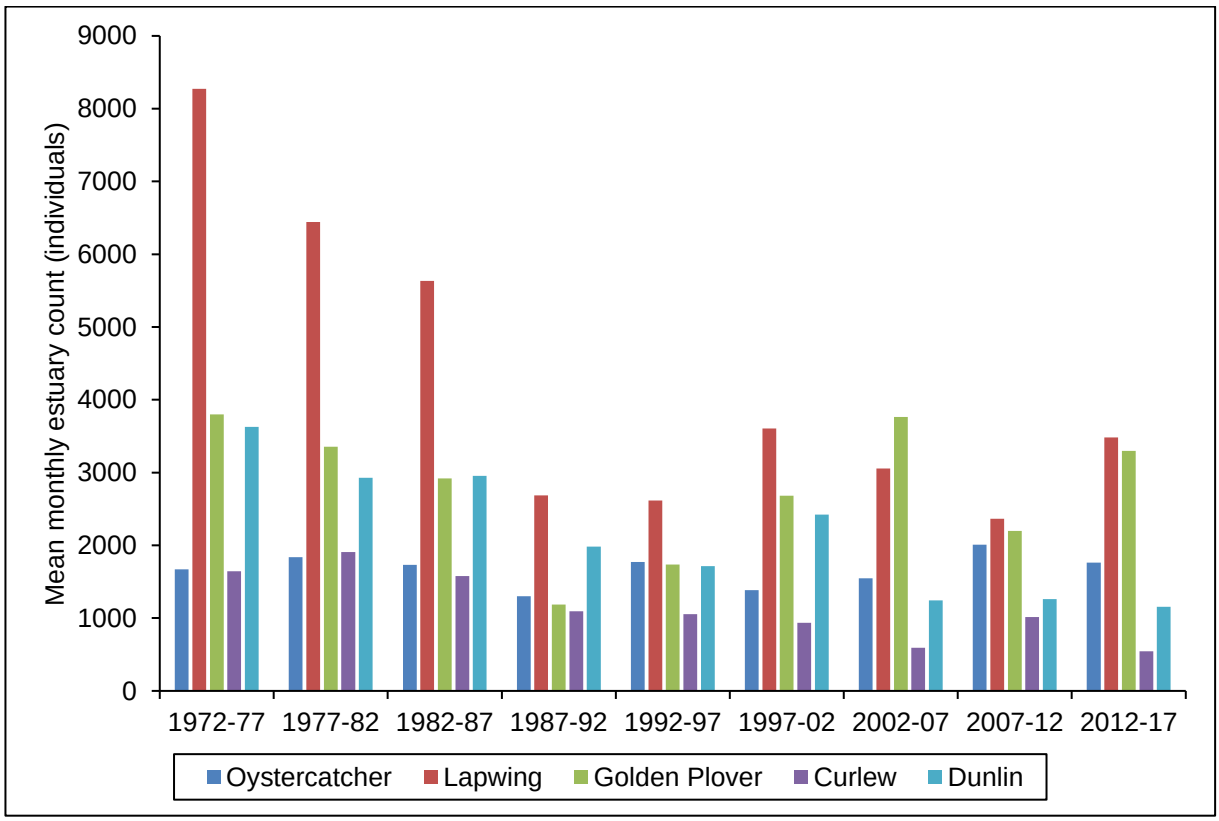

Figure 4. Five-year mean monthly counts of key wader species in the October to March period from 1972 to 2017 inclusive

2.2.15 It is however considered to be especially difficult to gather a count that is truly representative of the estuary population for Golden Plover. It is likely that a significant number of birds utilise surrounding farmland or nearby moorland at high tide due to a preference for open habitat. In addition, birds present on WeBS sectors in large flocks can be particularly challenging to count. Golden Plover tend to congregate in large dense groups when on the ground and often display flight activity reminiscent of a (Common) Starling Sturnus vulgaris murmuration, frustrating even the most patient efforts to obtain an accurate count.

2.2.16 The exclusion of non-native species, and Canada Goose *Branta canadensis* in particular, from the analysis of the wintering estuary waterbird populations is intended to avoid any false positive impact of their ever-increasing numbers on the native ornithological assemblage of the TTE.

2.3 Assessing the current situation

Low tide WeBS counts

2.3.1 The TTE has been fully surveyed only once using the WeBS low tide method: in the winter of 1994-95 when 19 sectors (Figure 5, Table 1) were counted (Musgrove and others, 2003). There was then a substantial gap in recording, until 2017-18 when 10 of these sectors were surveyed (Table 1). Despite the limitations of the available data, some useful observations on the proportional use of the estuary at low tide can still be made.

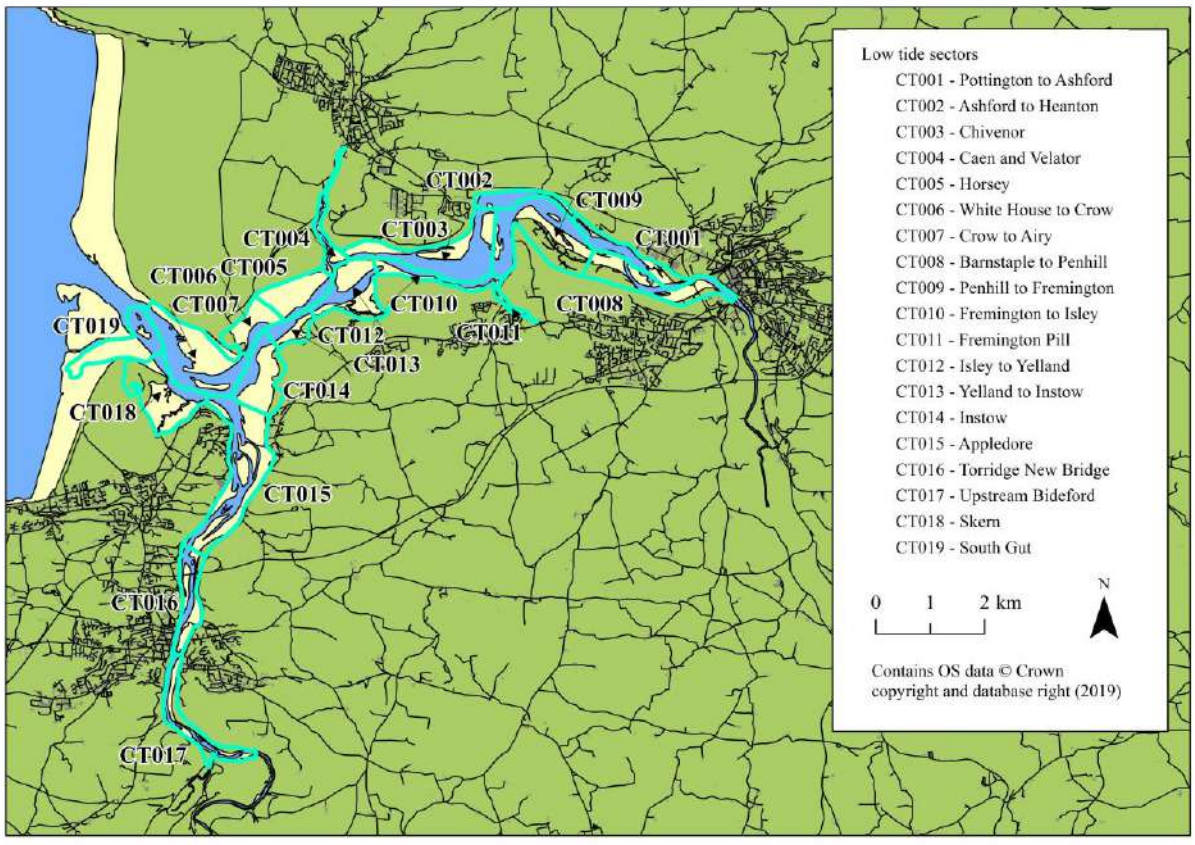

Figure 5. Annotated map of low tide WeBS sector boundaries

Table 1. Low tide WeBS sector codes, names and monthly survey coverage

Sector code	Sector Name	1994-95						2017-18					
		O	N	D	J	F	M	O	N	D	J	F	M
CT001	Pottington to Ashford		✓	✓	✓	✓							
CT002	Ashford to Heanton		✓	✓	✓	✓							
CT003	Chivenor		✓	✓	✓	✓			✓	✓		✓	
CT004	Caen and Velator		✓	✓	✓	✓							
CT005	Horsey		✓	✓	✓	✓							
CT006	White House to Crow		✓	✓	✓	✓			✓	✓	✓	✓	
CT007	Crow to Airy		✓	✓	✓	✓			✓	✓	✓	✓	
CT008	Barnstaple to Penhill		✓	✓	✓	✓							
CT009	Penhill to Fremington		✓	✓	✓	✓							
CT010	Fremington to Isley		✓	✓	✓	✓			✓	✓	✓	✓	
CT011	Fremington Pill		✓	✓	✓	✓							
CT012	Isley to Yelland		✓	✓	✓	✓			✓	✓		✓	
CT013	Yelland to Instow		✓	✓	✓	✓			✓	✓	✓	✓	
CT014	Instow		✓	✓	✓	✓			✓	✓	✓	✓	
CT015	Appledore			✓	✓	✓			✓	✓	✓	✓	
CT016	Torridge New Bridge			✓	✓	✓			✓	✓	✓	✓	
CT017	Upstream Bideford			✓	✓	✓			✓				
CT018	Skern		✓	✓	✓	✓							
CT019	South Gut		✓	✓	✓	✓							

2.3.2 Comparisons between years should be treated with caution due to the time elapsed, and lack of coverage between to assess interannual variation, but most sectors reflect the declining wintering bird population, which is particularly striking on the River Torridge sectors (Figure 6).

2.3.3 The Ashford to Heanton (CT002) Sectors and Penhill to Fremington (CT009) stand out as being particularly important in the winter of 1994-95, with mean monthly counts of 2,359 and 2,447 respectively (Figure 6). Lapwing and Golden Plover contribute the majority of birds recorded in these sectors, as well as in the neighbouring Chivenor (CT003) sector (Figure 7).

2.3.4 Unfortunately, Ashford to Heanton (CT002) and Penhill to Fremington (CT009) were not surveyed in 2017-18 (Table 1), although anecdotal observations throughout the winter of 2018-19 confirm the area is still of major importance for a wide range of WeBS species. Large numbers of Lapwing and Golden Plover may be seen at these sectors at low tide (Figure 7), alongside good numbers of most other common wintering species. Ducks are also particularly numerous in the Penhill to Fremington (CT009) sector (Figure 8).

2.3.5 The Chivenor (CT003) sector was surveyed in 2017-18 and returned remarkably similar mean total counts as in 1994-95 (Figure 6). However, it is of note that the maximum total monthly count had declined from 1,726 to 1,180.

2.3.6 Lapwing seem to utilise much of the estuary at low tide, and although a clear preference for the River Taw emerges, a number of birds also use the Torridge (Figure 7). It is interesting to speculate on the interaction of these birds with the rest of the estuary population as they also roost here at high tide (see Section 4.3).

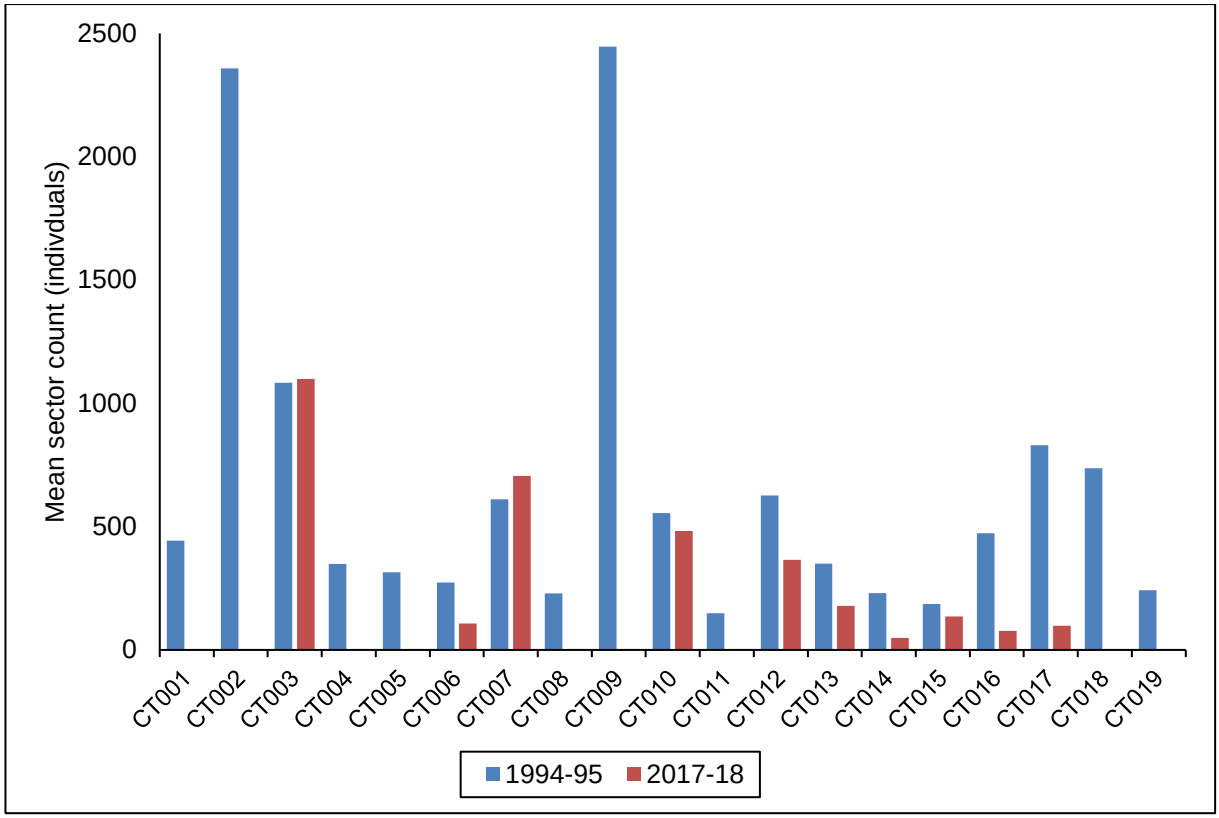

Figure 6. Mean monthly low tide counts of all filtered WeBS species in the October to March period in 1994-95 and 2017-18 where available

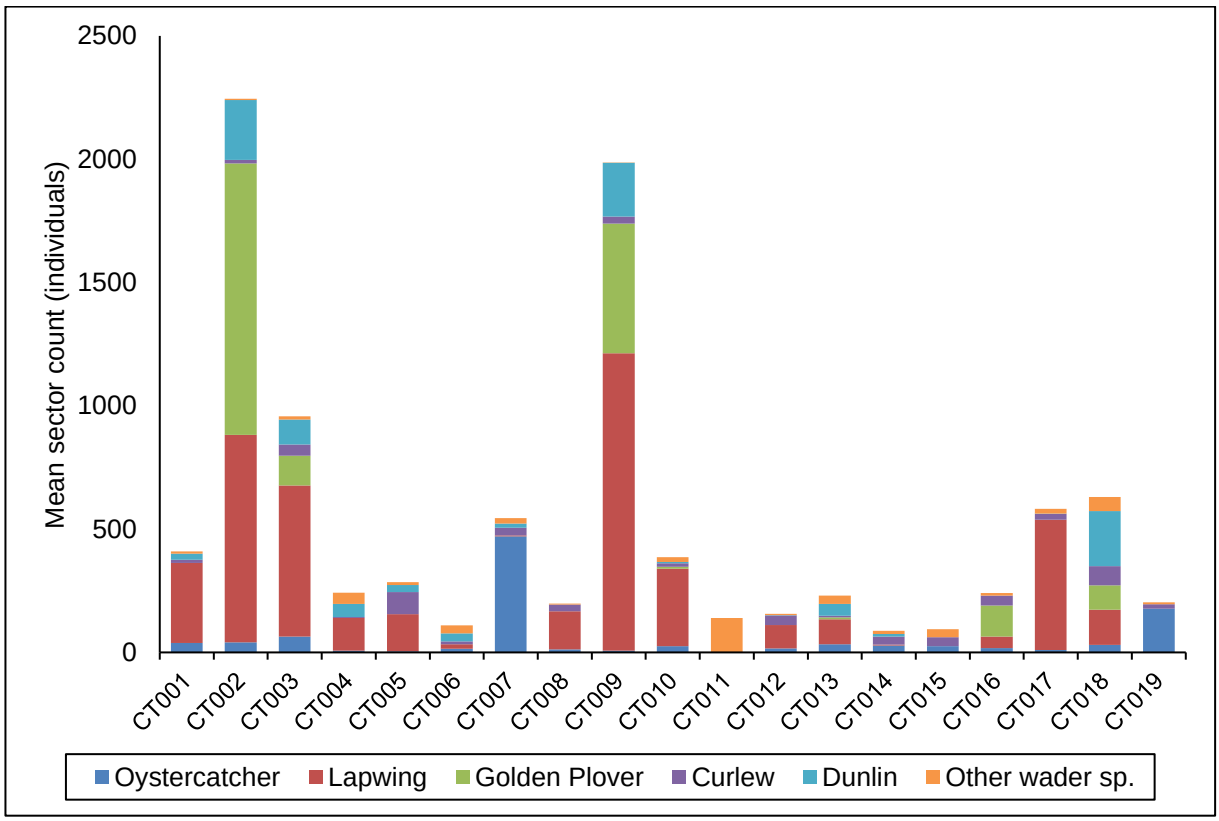

Figure 7. Mean monthly low tide counts of wader species by sector in the October to March period in 1994-95 and 2017-18 where available

2.3.7 Golden Plover are more site specific than Lapwing and the majority of wintering individuals tend to be found on the estuary in a single large flock. A reliance on Ashford to Heanton (CT002) and Penhill to Fremington (CT009) sectors (Figure 7) observed in 1994-95 could not be confirmed in 2017-18 although anecdotal observations suggest these areas are still important for this species at low tide.

2.3.8 Horsey Island itself is not included in the Horsey (CT005) sector, which instead relates to the intertidal area on the bordering section of the estuary (Figure 5), but anecdotal observations suggest that this is currently an extremely important low tide site for both Golden Plover and Lapwing.

2.3.9 When considering the other key wader species Curlew appear to be distributed throughout the estuary with a slight preference for the Horsey (CT005) and Skern (CT018) sectors (Figure 7).

2.3.10 Oystercatcher show a clear preference for the Crow to Airy (CT007) and South Gut (CT019) sectors (Figure 7), and this was backed up by anecdotal observations throughout the fieldwork component of this study.

2.3.11 Dunlin are widespread (Figure 7) but were found to be most numerous at Ashford to Heanton (CT002), Chivenor (CT003), Penhill to Fremington (CT009) and Skern (CT018).

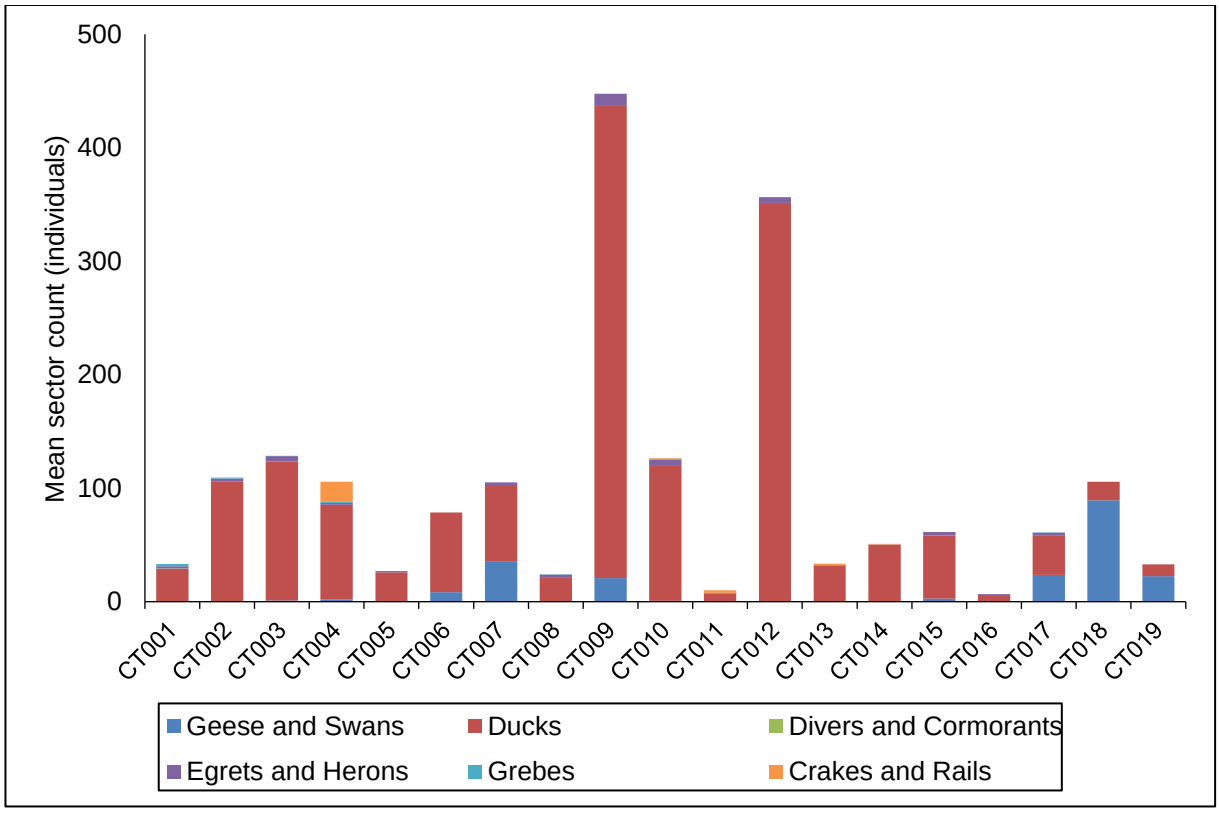

Figure 8. Mean monthly low tide counts of non-wader species groups by sector in the October to March period in 1994-95 and 2017-18 where available

2.3.12 Although widespread throughout the estuary at low tide, ducks show a clear preference for the Penhill to Fremington (CT009) and Isley to Yelland (CT012) sectors while Skern (CT018) is favoured by geese (Figure 8).

2.3.13 Gulls are typically found over large areas of the estuary, which may cover several sectors. Both rivers are well utilised, especially by Black-headed Gull *Chroicocephalus ridibundus* at Ashford to Heanton (CT002) on the Taw and Torridge New Bridge (CT016).

2.3.14 (European) Herring Gull *Larus argentatus* shows a preference for the more marine habitat in the estuary mouth at the Crow to Airy (CT007) sector (Figure 9).

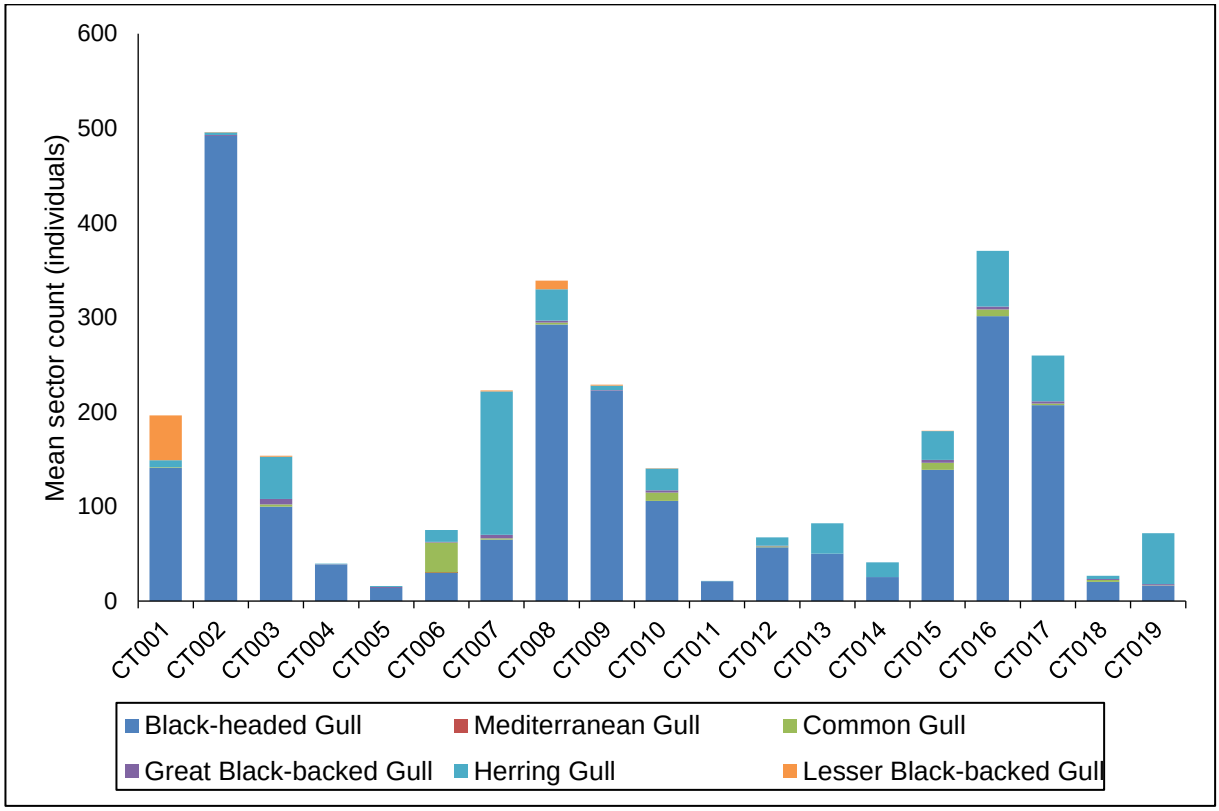

Figure 9. Mean monthly low tide counts of gulls by sector in the October to March period in 1994-95 and 2017-18 where available.

2.3.15 Overall, the neighbouring sectors of Ashford to Heanton (CT002) and Penhill to Fremington (CT009) can be seen to be of primary importance to WeBS species on the estuary at low tide hosting mean monthly counts in excess of two thousand individuals of WeBS species (Figure 10).

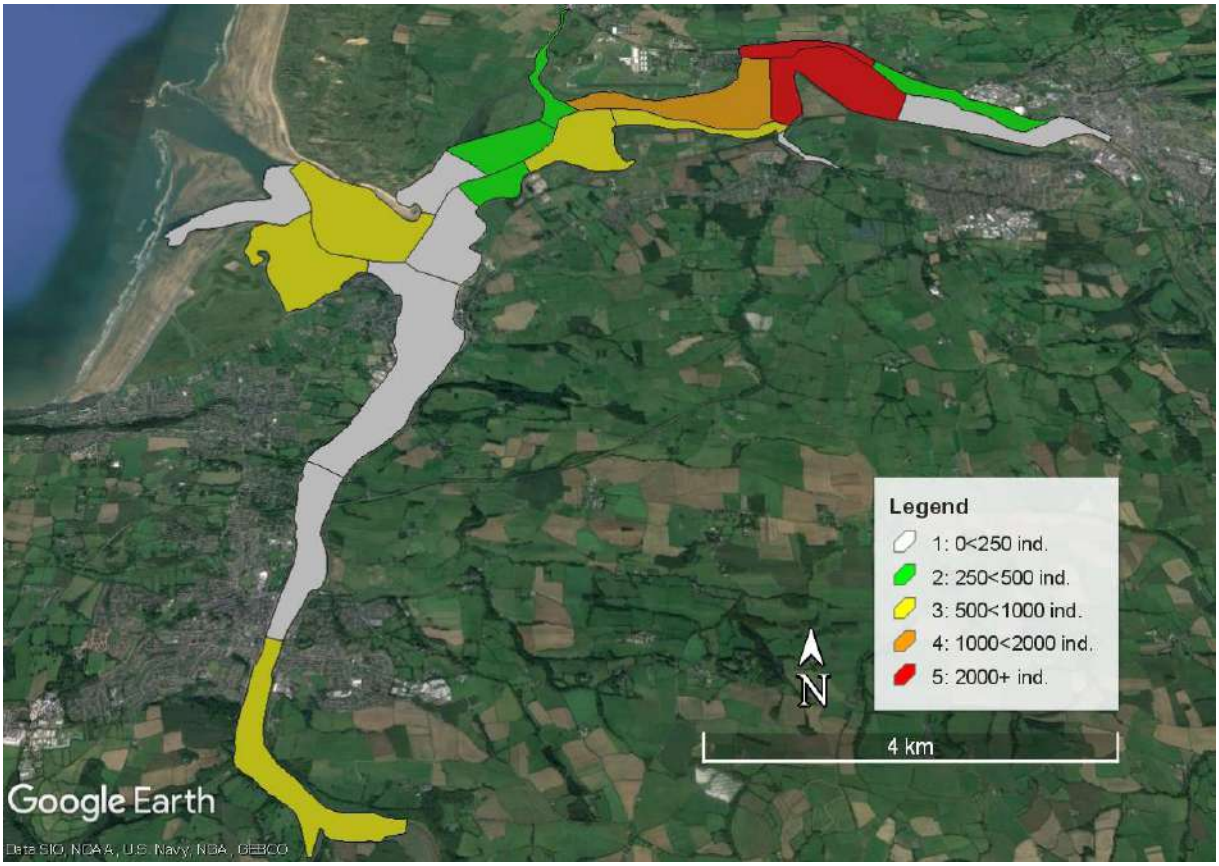

Figure 10. Mapped distribution of mean monthly counts of all WeBS species at low tide sectors in November to February of 1994-95 and 2017-18

2.3.16 Future low tide counts would benefit from counting the area within the Horsey Island outer sea wall as a new sector. Following the breach of the wall in the winter of 2017 the area is now tidal and currently offers an expanse of suitable habitat at low tide for a range of WeBS species which is heavily utilised for feeding and roosting.

2.3.17 The data gathered during low tide WeBS is vital to building a full understanding of the wintering bird populations on the estuary, and regular gathering of such data over all sectors should be considered as a priority.

2.3.18 Monitoring the utilisation of the estuary by wintering birds can help inform estuary spatial planning, while providing a mechanism to gauge the effectiveness of any management or mitigation measures.

2.3.19 Although conflict with human recreational users may be considered less of a risk at low tide, the assumption that birds can more easily relocate to other areas as there is more available habitat may not hold true. If food resources are concentrated in particular areas, disturbance of these areas could have significant impacts.

2.3.20 Furthermore, the major source of disturbance to wintering birds on the TTE comes from walkers with dogs (see Section 5), and the entire exposed intertidal area is often accessed by this estuary user group in many areas.

WeBS high tide core counts

2.3.21 The TTE is divided into 14 sectors for WeBS counts at high tide (Figure 11, Table 2). These sectors are distinct from the low tide sectors (Figure 5) to account for the changing habitat boundaries with tidal state.

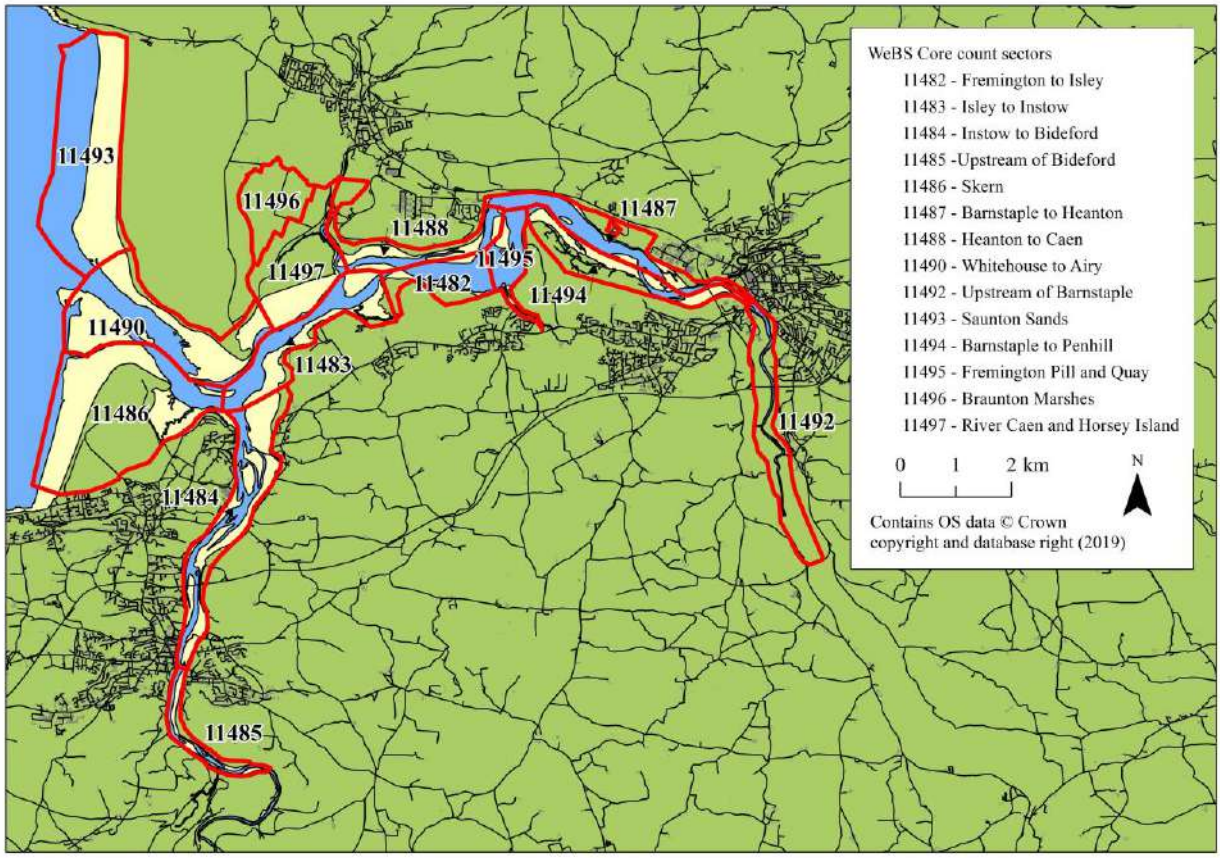

Figure 11. Map of WeBS core count sector boundaries

2.3.22 Complete data were available for individual core count sectors up to and including the October 2017 to March 2018 winter period, despite this data not yet having been officially processed and aggregated for the entire estuary. Coverage was variable (Table 2), but generally good.

2.3.23 Confounding the production of recent and comparative (to the whole estuary) sector data, some new WeBS sectors were created in 2014 by splitting down several large sectors.

2.3.24 In order to ensure that comparisons between sectors were valid, 4-year mean counts were calculated for the period October 2014 to March 2018. Waders (Figure 12) and other WeBS species (Figure 13) were then plotted by sector.

2.3.25 Clear patterns of species-specific utilisation of the estuary are apparent with four sectors, namely Skern (11486), River Caen and Horsey Island (11497), Isley to Instow (11483) and Heanton to Caen (11488), emerging as 'hotspots' for waders at high tide (Figure 12).

Table 2. WeBS core count sector names and monthly survey coverage from October 2014 to March 2018

Sector code	Sector Name	2014-15						2015-16						2016-17						2017-18					
		O	N	D	J	F	M	O	N	D	J	F	M	O	N	D	J	F	M	O	N	D	J	F	M
11485	Upstream of Bideford	✓	✓	✓	✓			✓			✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓
11484	Instow to Bideford		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11486	Skern	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
11490	White House to Airy	✓	✓	✓	✓	✓		✓					✓			✓		✓	✓	✓	✓	✓	✓	✓	
11493	Saunton Sands	✓			✓			✓	✓		✓			✓	✓		✓	✓	✓	✓	✓		✓	✓	
11496	Braunton Marshes	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11497	River Caen and Horsey Island	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11483	Isley to Instow	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11488	Heanton to Caen	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11482	Fremington to Isley	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	
11495	Fremington Pill and Quay	✓	✓	✓	✓		✓				✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11487	Barnstaple to Heanton	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11494	Barnstaple to Penhill	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11492	Upstream of Barnstaple	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓

2.3.26 The highest mean counts of Lapwing, Golden Plover, Curlew, Dunlin, and Oystercatcher were all recorded within the four 'hotspot' sectors. Redshank bucks this trend as a result of a preference for the Fremington Pill and Quay (11495) sector (Figure 12). Also of note is a high count of 'other' wader species at Saunton Sands (11493), which relates to Sanderling *Calidris alba*.

2.3.27 Away from the at high tide 'hotspots', Golden Plover and Lapwing use Braunton Marshes (11496), while Lapwing also use several other sectors in lower numbers (Figure 12).

2.3.28 Curlew are found throughout the estuary with the 'hotspot' sector of Isley to Instow (11483) being of primary importance, followed by Barnstaple to Heanton (11487). It is suggested that birds at the latter sector are more likely to be feeding around high tide rather than roosting at high tide.

2.3.29 Species other than waders are not so concentrated at high tide. However, the highest mean counts of 'non-waders' are to be found in the same sectors as for waders, such as Heanton to Caen (11488) and Isley to Instow (11483), with Skern (11486) also being important. Barnstaple to Penhill (11494) is also used particularly by geese (Figure 13). In contrast, River Caen and Horsey Island (11497) is not so well used.

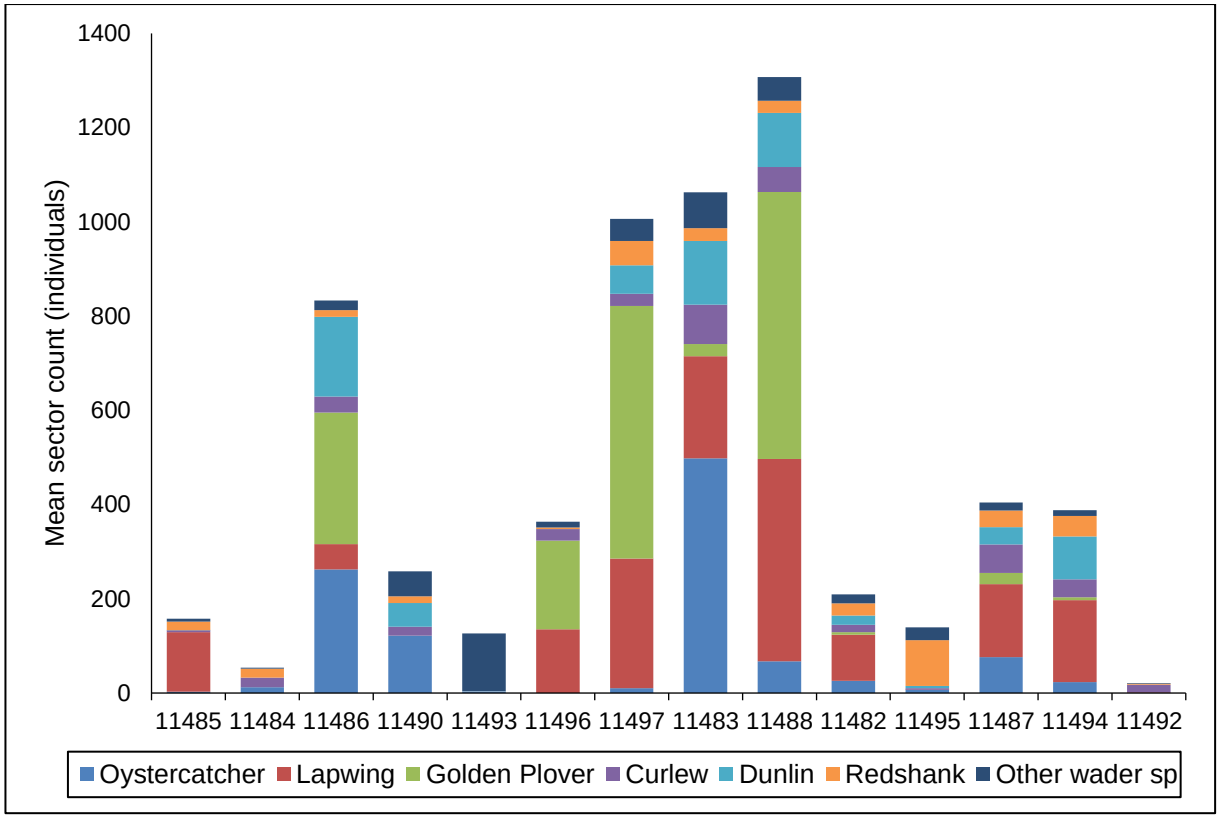

Figure 12. Mean sector counts of waders on WeBS core counts in October to March 2014-18

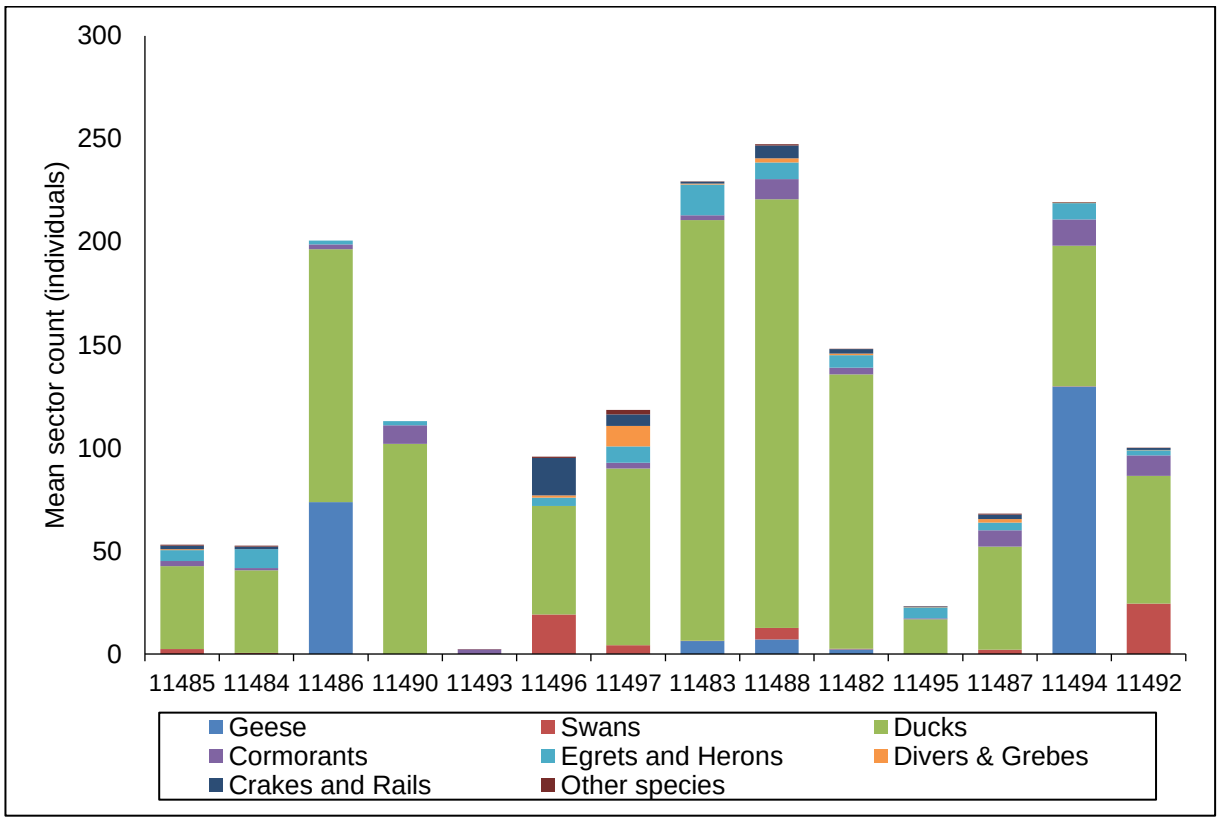

Figure 13. Mean sector counts of non-wader species groups on WeBS core counts in October to March 2014-18

The distribution of birds in the winter of 2018-19

2.3.30 Over the course of the study period, ongoing WeBS core counts have been collated and are presented here to define the current situation regarding estuary utilisation by wintering birds and to give specific context to the disturbance survey work.

2.3.31 Following the breach of the Horsey Island sea wall it was deemed useful to isolate this recent data to investigate the subsequent, albeit short-term, response of birds.

Table 3. WeBS core count sector names and survey coverage in winter 2018-19

Sector code	Sector Name	2018-19				
		14th Oct	11th Nov	9th Dec	13th Jan	10th Feb
11485	Upstream of Bideford	✓	✓	✓	✓	✓
11484	Instow to Bideford	✓	✓		✓	✓
11486	Skern	✓	✓	✓	✓	✓
11490	White House to Airy	✓	✓	✓	✓	✓
11493	Saunton Sands	✓	✓			
11496	Braunton Marshes	✓	✓	✓	✓	✓
11497	River Caen and Horsey Island	✓	✓	✓	✓	✓
11483	Isley to Instow	✓	✓	✓	✓	✓
11488	Heanton to Caen	✓	✓	✓	✓	✓
11482	Fremington to Isley	✓	✓	✓	✓	✓
11495	Fremington Pill and Quay	✓	✓	✓	✓	
11487	Barnstaple to Heanton	✓	✓	✓	✓	✓
11494	Barnstaple to Penhill	✓	✓	✓	✓	✓
11492	Upstream of Barnstaple	✓	✓	✓	✓	✓

2.3.32 WeBS core count survey coverage in the winter of 2017-18 was good (Table 3), although counts at Saunton Sands (11493) ceased after November. Casual counts for the sector are still being collected and uploaded to the WeBS database and have not been considered here.

2.3.33 There are some clear differences in distribution during the 2018-19 winter (Figure 14) compared with the mean count distribution for the preceding four-year period (Figure 12). Most notably, Golden Plover and Lapwing appear to have concentrated in the River Caen and Horsey Island (11497) sector (Figure 14 & 17).

2.3.34 The distribution of other WeBS species (Figure 15) is broadly similar to the previous 4-year period (Figure 13). Gulls have not been considered when calculating 4-year mean counts although distribution in 2018-19 has been plotted (Figure 16) and is thought to be representative of the long-term situation. A similar distribution to that found at low tide is apparent (Figure 9).

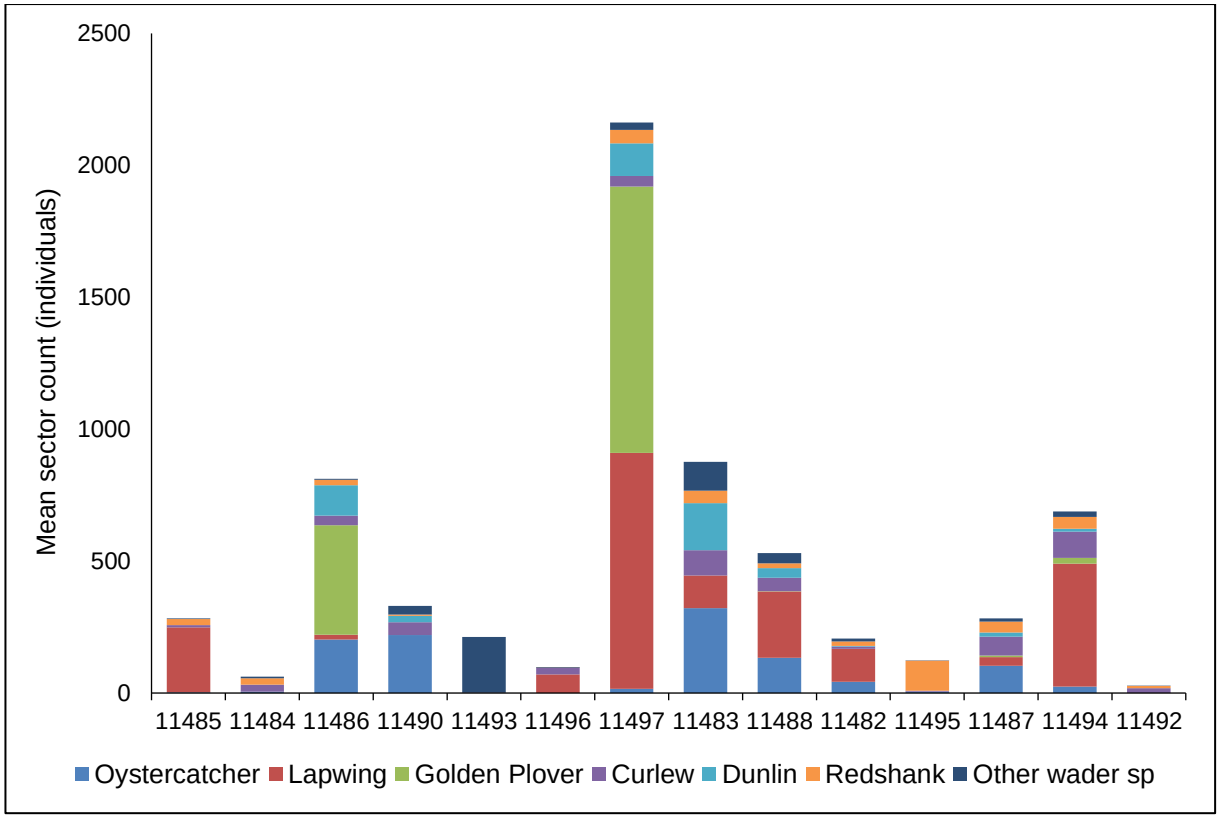

Figure 14. Mean sector counts of waders on WeBS core counts in October to February 2018-19

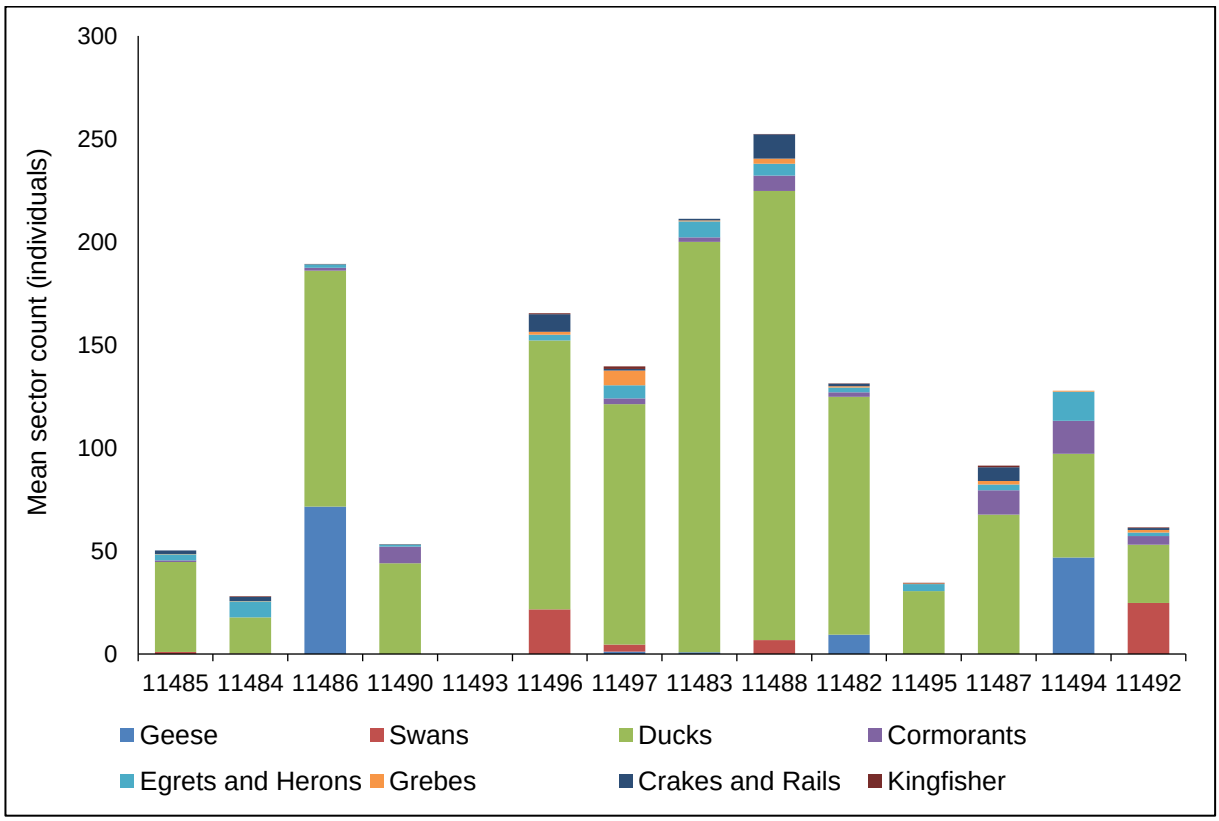

Figure 15. Mean sector counts of non-wader species by group on WeBS core counts in October to February 2018-19

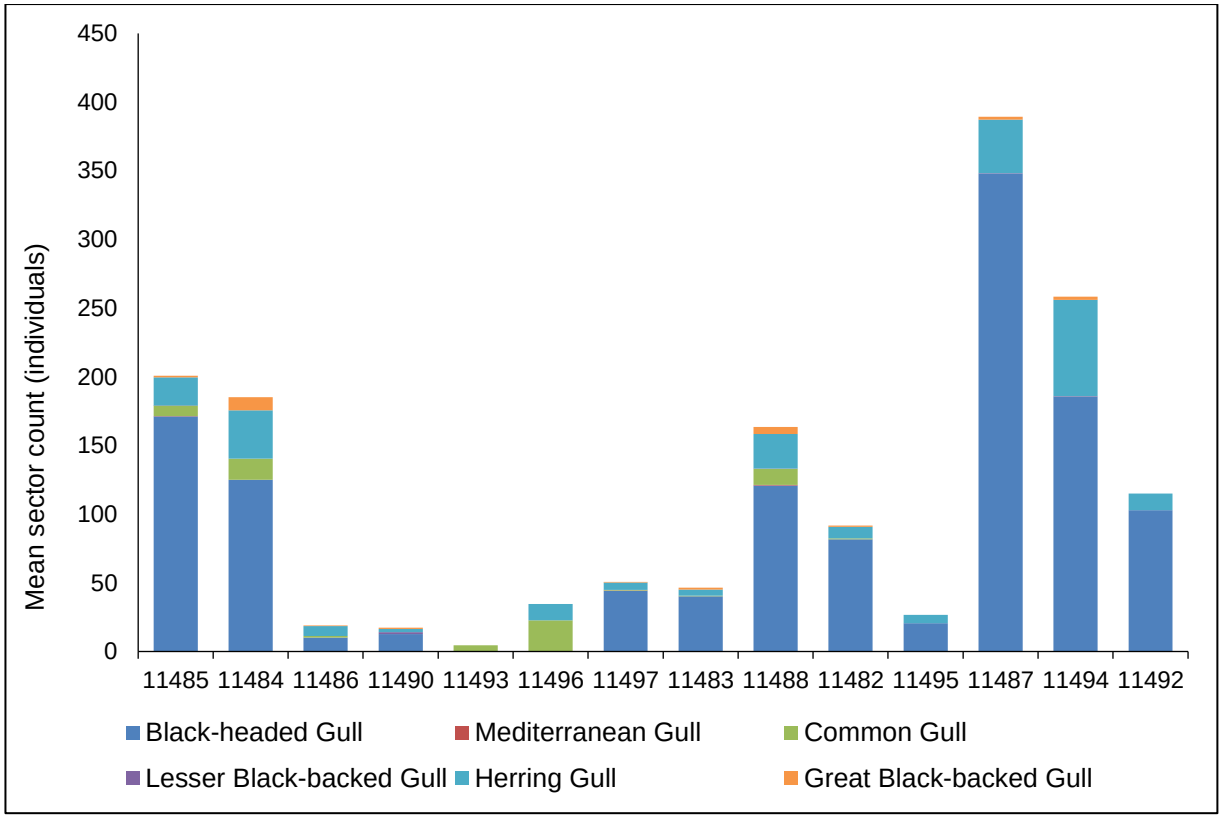

Figure 16. Mean sector counts of gull species on WeBS core counts in October to February 2018-19

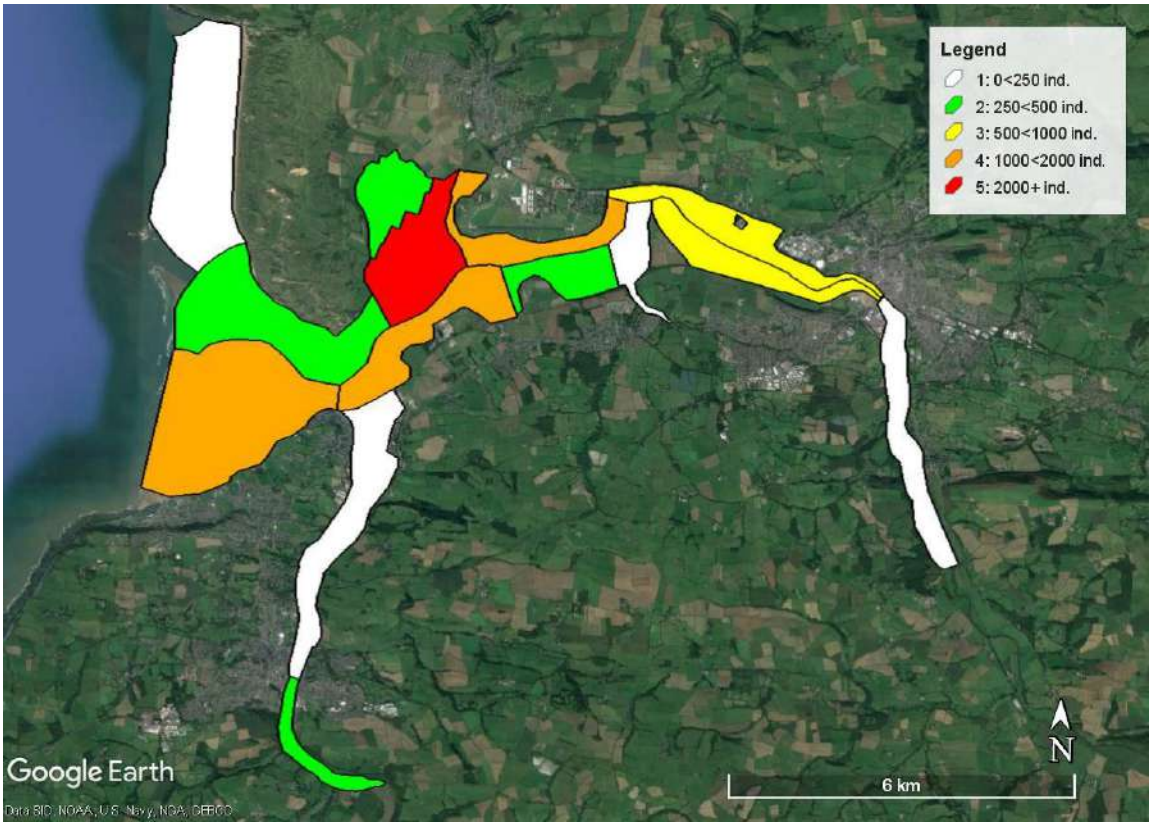

Figure 17. Mapped distribution of mean monthly sector counts of all WeBS species at high tide core count sectors in October to February 2018-19

Whole estuary populations

2.3.35 In order to determine the proportional use of the estuary by WeBS species and assess the relative importance of high tide roosts during the focal period of the current study, mean of the monthly maximum in each year, peak monthly and overall mean monthly counts from the whole estuary were calculated for regularly encountered species in the October to March period from 2012 to 2017 inclusive(Table 4).

2.3.36 It should be noted that October and March may be better described as passage periods around the core wintering period of November to February for many WeBS species, which may be present in greater number for short periods of time.

2.3.37 Similar work undertaken on the Severn Estuary had defined important high tide roosts as holding >1% of a species estuary population during ≥50% of WeBS counts (Latham, 2015). However, the Severn Estuary SPA holds a far greater wintering population than the TTE, with an assemblage in excess of 60,000 birds.

Table 4. Five-year means of annual maximum monthly estuary count, five-year peak monthly estuary count, and five-year monthly mean estuary count with 1% and 5% populations for regularly encountered WeBS species in the October to March period 2012-2017.

	2012-2017								
Species	**Mean of annual maximum monthly count**	**1%**	**5%**	**Peak monthly count**	**1%**	**5%**	**Mean monthly count**	**1%**	**5%**
Brent Goose	358	4	**18**	556	6	**28**	204	2	**10**
Mute Swan	62	1	**3**	88	1	**4**	42	0	**2**
Shelduck	186	2	**9**	222	2	**11**	115	1	**6**
Wigeon	610	6	**31**	770	8	**39**	340	3	**17**
Mallard	286	3	**14**	480	5	**24**	166	2	**8**
Pintail	18	0	**1**	32	0	**2**	6	0	**0**
Teal	560	6	**28**	760	8	**38**	300	3	**15**
Spoonbill	7	0	**0**	10	0	**1**	4	0	**0**
Grey Heron	25	0	**1**	34	0	**2**	14	0	**1**
Little Egret	73	1	**4**	111	1	**6**	43	0	**2**
Cormorant	71	1	**4**	87	1	**4**	46	0	**2**
Oystercatcher	1764	18	**88**	2240	22	**112**	1187	12	**59**
Lapwing	3484	35	**174**	4622	46	**231**	1402	14	**70**
Golden Plover	3296	33	**165**	4220	42	**211**	1393	14	**70**
Grey Plover	146	1	**7**	202	2	**10**	70	1	**4**
Ringed Plover	73	1	**4**	105	1	**5**	31	0	**2**
Curlew	544	5	**27**	640	6	**32**	365	4	**18**
Black-tailed Godwit	53	1	**3**	179	2	**9**	33	0	**2**
Bar-tailed Godwit	25	0	**1**	41	0	**2**	9	0	**0**
Turnstone	78	1	**4**	114	1	**6**	38	0	**2**
Knot	43	0	**2**	143	1	**7**	16	0	**1**
Sanderling	203	2	**10**	306	3	**15**	96	1	**5**
Dunlin	1157	12	**58**	1678	17	**84**	521	5	**26**
Snipe	91	1	**5**	137	1	**7**	38	0	**2**
Common Sandpiper	4	0	**0**	5	0	**0**	1	0	**0**
Redshank	414	4	**21**	574	6	**29**	269	3	**13**
Greenshank	31	0	**2**	49	0	**2**	17	0	**1**

2.3.38 Due to the generally small populations of wintering WeBS species on the TTE, the use of 1% population thresholds would frequently result in very low numbers of birds triggering important roost status (Table 4), it is suggested that a roost regularly containing over 5% of the 5-year mean estuary population on >50% of WeBS counts is a more suitable threshold to determine whether a roost of a specific species qualifies as being of importance in an estuary context.

2.3.39 Alternatively, as the 1% threshold is so low for all wintering species (Table 4) it may prove more prudent to consider any aggregation of waterbirds on the TTE as of importance.

3 Identification of high tide roosts

3.1 Aims

3.1.1 Wintering birds may be particularly vulnerable to disturbance at high tide when available habitat is limited, and birds are often aggregated in large dense flocks that may be closer to access points and areas frequented by recreational estuary users. Therefore, information on high tide roost sites is invaluable to ensure they can be protected. To this end, this section reports on the outcomes of the following project aims;

- Collect information on the locations and extent of high tide roost sites, attendant bird assemblages and physical characteristics. Identify areas of the estuary and the surrounding land of greatest importance to wintering waterbirds.
- Capture the wider knowledge of local WeBS counters regarding recreational and commercial impacts and functionally linked land on and around the estuary.
- Identify the main causes and locations of bird disturbance within each WeBS sector. Gather information on how birds react, and where they relocate to when disturbed in relation to available habitat.

3.2 Methodology

Engagement with WeBS counters

3.2.1 The WeBS team was engaged through individual face-to-face or phone interviews, email communication and a presentation and discussion session at the North Devon WeBS team AGM. A detailed and illustrated (with maps) questionnaire was used to gather the required data on high tide roosts in each high tide core count sector. The questionnaire (Appendix 1) was designed to;

- Identify specific locations and spatial extent (by way of marking on a map) of the high tide roost sites used by wintering waterbirds.
- Record environmental characteristics and describe the bird assemblage at each roost location, including any observed behaviour and patterns of use.

- Gather further information on bird utilisation of the estuary including preferred feeding areas, general patterns of use and functionally linked land.
- Identify and detail the main perceived causes, locations and severity of disturbance to birds, and their subsequent responses, within each WeBS sector.
- Outline any historical changes in perceived levels of disturbance, bird numbers, general distribution within, and utilisation of, the estuary, and roost locations.

3.2.2 All high tide roost sites were visited to confirm the data supplied. Counts of roosting birds during these visits and incidental observations during disturbance survey fieldwork (Section 5) have been used in conjunction with supplied estimates to sense check or update numbers (e.g. maximum counts) as appropriate.

Structure of sector accounts

3.2.3 The high tide roost findings are presented within wider sector accounts. The WeBS core count sectors are used. The sector accounts are structured as follows:

- Description and overview map showing the sector boundary with any high tide roosts marked.
- A table outlining the species, numbers and behaviour at the roost as well as the sites physical characteristics.
- A description of the nature of disturbance at the roost(s).
- An overview of potential management and mitigation of disturbance specific to the roost(s).

Guidance for interpreting tabulated high tide roost data

3.2.4 In addition, the tabulated, quantitative information about each roost should be interpreted according to the following guidance:

- **Max count** and **typical count** – counts by species over the past five-year period (if possible) as established from interviews with WeBS counters and adjusted if data gathered during disturbance surveys and other observations are considered reliable.The typical count reflects the WeBS counters best estimate of the number of birds they would expect to be present in the winter period under 'normal' conditions.
- **>5% of estuary population** - The 5-year mean monthly count has been used to determine roost importance at the 5% population level. Where typical counts are provided these are used to assess importance. Where WeBS counters only had confidence in maximum counts these have been used to define relative importance when the species site fidelity has been classed as medium or high
- **Fidelity** - % of visits present H = High (>65%), M = Medium (35-65%), L = low (<35%), U = Uncertain.
- **Typical behaviour** - % feed and % rest represent approximate time budgets for individual birds.
- Gulls were not recorded as a priority but have been included where WeBS counters felt they were an important and consistent roost component and were able to make good count estimates.

3.3 Overview of high tide roost results

3.3.1 A total of twenty-one high tide roosts were identified, described and mapped (Table 5, Figure 18).

3.3.2 A concentration of high tide roosts can be seen on northern and southern banks of the lower reaches of the River Taw, and around the estuary mouth (Figure 18).

Table 5. Overview of high tide roosts identified in each WeBS count sector with supplementary information

Sector code	Sector Name	High tide roost count	Roost types	Secondary or nearby areas of importance for roosting and feeding
11485	Upstream of Bideford	1	Wader	Further upstream, riverside marshes
11484	Instow to Bideford	1	Egret & Heron	Southcott Valley – wet grazing fields are important for ducks and waders. Appledore shipyard roof (gull roost).
11486	Skern	2	Mixed	Neighbouring fields around Skern Lodge used by Curlew
11490	White House to Airy	3	Mixed, wader	Airy Point used by feeding and roosting birds (Sanderling, Oystercatcher, Cormorant).
11493	Saunton Sands	0	-	
11496	Braunton Marshes	1	Wader	
11497	River Caen and Horsey Island	3	Mixed	
11483	Isley to Instow	3	Mixed, wader	Instow cricket pitch and any suitable surrounding fields are used by feeding and roosting Curlew and Oystercatcher
11488	Heanton to Caen	2	Mixed	
11482	Fremington to Isley	2	Mixed	
11495	Fremington Pill and Quay	2	Wader, Egret & Heron	
11487	Barnstaple to Heanton	0	-	Roadside fields at Ashford (6 figure grid reference: SS524350 and SS520350) regularly used by Lapwing when suitable habitat is available therein. Small numbers of Oystercatcher feed on Barnstaple rugby pitch.
11494	Barnstaple to Penhill	1	Mixed	
11492	Upstream of Barnstaple	0	-	Newbridge area floodplain

3.3.3 The River Torridge is of less importance for roosting birds at high tide, in large part due to the narrower channel and reduced availability of rock, beach, saltmarsh or other suitable habitat compared to the Taw.

3.3.4 The distribution of high tide roosts is undoubtedly informed primarily by the availability of suitable habitat at high tides. However, it is of note and highly unlikely to be by coincidence, that nearly all of the high tide roost sites identified are at locations that might be considered relatively inaccessible, or rarely accessed, from a human recreational activity point of view.

3.3.5 The least consistently used of all identified roost sites can be found on the tip of Crow Point, an easily accessible and popular beach walking route. Anecdotal observations throughout the winter suggest that this roost is highly disturbed and now only used during overnight or very early morning high tides (see Section 4.6).

3.3.6 Areas of secondary importance at the WeBS sectors and in the vicinity of the estuary are identified (Table 5). This information should not be regarded as complete and further work is required to fully establish patterns of use by WeBS species in the estuary surrounds. However, the locations detailed here should be considered important for wintering WeBS species using the TTE.

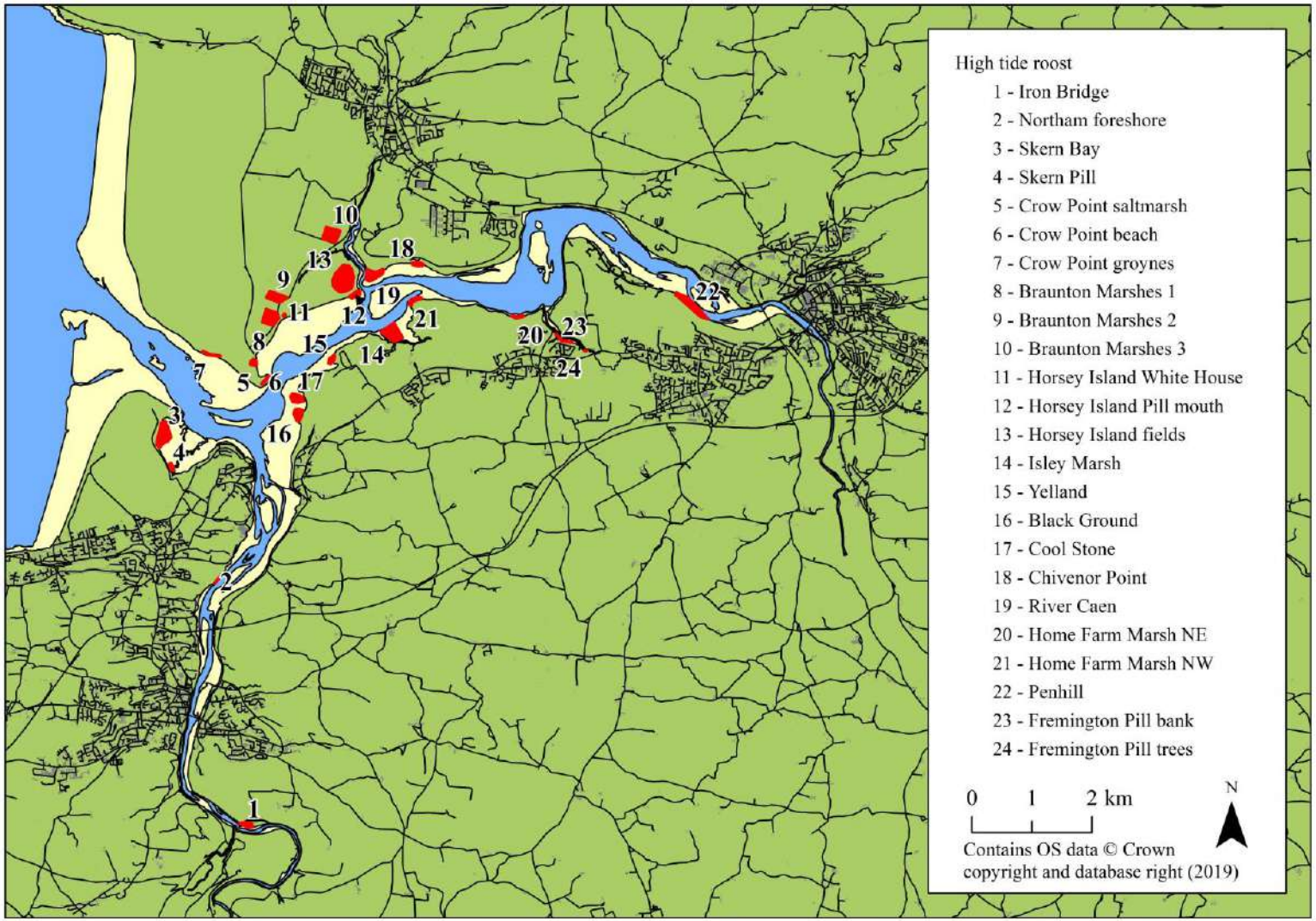

Figure 18. Overview map showing high tide roost sites and WeBS core count sector boundaries

3.4 Sector accounts

Sector 11485 Upstream of Bideford

3.4.1 The sector upstream of Bideford runs from Bideford Long Bridge, and officially ends at Pillmouth, the farthest reaches of the Torridge viewable from the 'Iron Bridge' on the Tarka Trail (Figure 19). However, the WeBS counter has for many years counted as far as Weare Gifford, viewing the Pillmouth marshes that have formed as the river meanders, from a vantage point on the road at Halspill on the opposite bank. Small numbers of Redshank and Curlew may roost here at high tide and (Eurasian) Teal *Anas crecca* are often present on the river.

3.4.2 Much of the sector is bound on the western bank of the Torridge by the A386, a busy road connecting Bideford to Torrington. This side of the river is therefore dominated by the reinforced bank at high tide. There is access to the foreshore from two laybys, the most prominent of which is known as 'Little America' that has concrete steps providing convenient access to the river for anglers and kayakers.

3.4.3 The eastern bank is characterised by an almost continuous marsh, much of which is incorporated within a designated local nature reserve (LNR), Kynochs Foreshore. The site is a substantial area of saltmarsh bound by reedbed on the landward boundary and mudflats on the shoreline. The eastern bank is flanked by the Tarka Trail from Bideford to the Iron Bridge, where both the trail and the A386 turn away from the course of the Torridge.

Figure 19. Aerial view of sector 11485 (red boundary), the high tide roost (white boundary) within it and surrounds.

3.4.4 Despite apparently abundant and undisturbed potential habitat, there is just one important and consistent high tide roost within this sector (Figure 19). This is an area of saltmarsh on the north bank of the Torridge immediately upstream of an old rail bridge, locally known as the 'Iron Bridge' which now serves the Tarka Trail. Iron Bridge consistently hosts a significant Lapwing roost at high tide (Table 6).

Iron Bridge high tide roost

Table 6. Iron Bridge roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Lapwing	600	190	✓	H	5	95	
Curlew	10	5		M	10	90	

Roost site habitat, substrate composition, other features (%)		Further description and notes
Saltmarsh	80	OS grid ref: SS 463 246 Estimated roost area: 1800m2
Mud	10	
Water	10	

3.4.5 The sector also appears to be important for gulls, with large aggregations usually present during WeBS core count visits, loafing on the river in the Iron Bridge area.

Disturbance at the Iron Bridge high tide roost

3.4.6 The roost is largely undisturbed. Access onto the saltmarsh is not straightforward with no clear paths, limiting the potential for terrestrial recreation. The Tarka Trail appears to be sufficiently far away to mean that the constant stream of walkers, joggers and cyclists, some of which are especially noisy, do not appear to impact roosting birds.

3.4.7 Waterborne disturbance has the potential to be more of an issue but is rarely observed. This stretch of the river is popular for canoeing and kayaking so disturbance to the roost is certainly possible if a close approach is made.

Potential management and mitigation for the Iron Bridge high tide roost

3.4.8 At present, the only potential management and mitigation deemed appropriate is to increase awareness of this high tide roost amongst water users.

Sector 11484 Instow to Bideford

3.4.9 The Instow to Bideford sector is substantial, covering 2.74 km^2 and including some of the most developed areas of estuary shoreline at Appledore and Bideford where quayside and slipways allow access to the estuary (Figure 20).

3.4.10 The sector also includes Instow beach, a very popular area for recreational activities. The Tarka Trail runs on a raised and reinforced bank down the eastern bank of the Torridge from Instow to East-the-Water.

3.4.11 Mudflats contained within two prominent bays fringe much of the engineered shoreline to the south of Instow and are flooded at high tide. Saltmarsh, particularly under Torridge Bridge, remains exposed on all but the highest of tides.

3.4.12 The South West Coast Path (SWCP) runs above the western bank of the Torridge, which is dominated by man-made structures and mudflats. At low tide, extensive sandbanks are exposed in the channel. At high tide, there is little available habitat to attract roosting birds along the banks of the lower River Torridge and few birds are to be found (see Section 3).

3.4.13 Small numbers of waders may be found in unusual places, with Oystercatchers occasionally roosting in small numbers atop Appledore shipyard or nearby wrecked vessels, and, if undisturbed, Redshank are occasionally observed roosting on harbour wall or slipway structures especially on very high spring tides. However, the single high tide roost on the sector does not hold waders.

Figure 20. Aerial photo of sector 11484 (red boundary), the high tide roost (white line) within it and surrounds.

Northam foreshore high tide roost

3.4.14 To the north east of Cleave Quay, the muddy foreshore between Bideford and Appledore is inundated at high tide, leaving a rocky tree lined cliff face exposed above the tide line. This area holds the only consistent high tide roost in the sector and is used by herons and/or egrets (Table 7).

Table 7. Northam foreshore roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		Notes
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	
Grey Heron	8	4	✓	H	0	100	
Little Egret	4	1	✓	L	0	100	
Roost site habitat, substrate composition, other features (%)				**Further description and notes**			
Trees			50	OS grid ref: SS 460 288 Estimated roost area: 200m2			
Rock and cliff face			50				

3.4.15 The use of this roost appears to have changed recently, as it previously held Little Egret *Egretta garzetta* almost exclusively (J. Whittington, WeBS counter, *pers comm*). Frequent observations this winter indicate that the roost is currently dominated by Grey Heron *Ardea cinerea* (Figure 21).

Figure 21. Grey Heron roost on the Northam to Appledore foreshore

Disturbance at the Northam foreshore high tide roost

3.4.16 Access to the roost area is very difficult by land at high tide. However, on rare occasions a walker may (incredibly) attempt to scramble along the rock faces. This invariably results in failure, although not always before roosting birds are flushed.

3.4.17 The full range of waterborne traffic may be seen more frequently, especially at weekends and in good weather, and can flush roosting birds if within close

proximity. However, generally speaking there is little activity on the estuary in this area through the winter period.

3.4.18 A house boat is moored in a bay to the east of the area used by roosting birds, although it does not appear to have any detrimental impact on the roost.

Potential management and mitigation for the Northam foreshore high tide roost

3.4.19 The terrain is considered to be ample deterrent to land-based recreation. Increasing awareness amongst water users may help prevent disturbance to the roost from water-based activities.

Sector 11486 Skern

3.4.20 This sector is very large at 5.84km^2 and includes much of Westward Ho! beach to the South Gut, Northam Burrows and the Skern itself, a large horseshoe shaped shallow bay fringed by reinforced banks, the SWCP and patches of saltmarsh and rocky beach (Figure 22).

3.4.21 At low tide, extensive intertidal areas are exposed in this sector. Sand at Westward Ho! and Grey Sands out to the South Gut gives way to bedrock allowing the formation of pools as the tide retreats at the estuary mouth. This area may be utilised by a range of WeBS species for feeding and Golden Plover frequently roost amongst the cobbles here at lower tides.

3.4.22 The foreshore between the Skern Pill and Appledore is a particularly important foraging area as the tide retreats, as are the wider mudflats and creeks exposed within the bay.

3.4.23 At high tide, birds become concentrated in Skern Bay. There are two core high tide roost sites (Figure 22), although during neap or lower high tides birds may also be found roosting in smaller groups around the whole bay, if they remain undisturbed.

3.4.24 Due to their proximity to one another, similarity in disturbance issues, and the potential to implement management and mitigation concurrently, the two Skern high tide roost sites, namely Skern Bay and Skern Pill are considered together in the discussion regarding disturbance and any mitigation required below.

Figure 22. Aerial photo of sector 11486 (red boundary), the high tide roosts (white boundaries) within it and surrounds.

Skern Bay high tide roost

3.4.25 The primary Skern roost forms in the north western corner of the bay and is associated with a raised area of saltmarsh. The area can be largely flooded by spring tides that may reduce the numbers of birds present (Figure 23).

3.4.26 A wide variety of WeBS species may use this roost site (Table 8), which usually holds high numbers of birds overall, although numbers by species can be highly variable. Golden Plover also frequently use the site to roost on the saltmarshes and mudflats at lower states of tide.

Table 8. Skern Bay high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Brent Goose	300	60	✓	M	50	50	Frequently just offshore
Shelduck	70	25	✓	H	50	50	Frequently just offshore
Wigeon	90	40	✓	H	70	30	Frequently just offshore
Grey Heron	2	0		L	0	100	
Little Egret	5	2	✓	H	40	60	
Oystercatcher	400	200	✓	H	5	95	
Curlew	80	40	✓	H	5	95	
Grey Plover	20		✓	M	10	90	
Golden Plover	2000	300	✓	M	2	98	
Redshank	25	20	✓	H	20	80	
Bar-Tailed Godwit	12	0		L	20	80	
Knot	5	0		L	30	70	Mostly passage birds
Dunlin	400	150	✓	H	60	40	

Roost site habitat, substrate composition, other features (%)		Further description and notes
Saltmarsh	70	OS Grid ref: SS 450 311 Estimated roost area: 5000m^2 Spring tides can inundate much of the available habitat.
Water	10	
Mud	10	
Shingle	5	
Sand	5	

Figure 23. An 8.4 m spring high tide reduces the Skern Bay roost to a collection of small islands.

Skern Pill high tide roost

3.4.27 A smaller, but distinctly separate high tide roost (Table 9) consistently forms around or near an outfall pipe and across an area of saltmarsh to the west of the mouth of the Pill, which is the outflow of the major creek system that drains Northam Burrows. This roost site can be completely inundated at high tide and most birds will join the main Skern roost to the north, assuming there is available habitat.

Table 9. Skern Pill high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Shelduck	20	10	✓	H	50	50	Frequently offshore
Wigeon	100	40	✓	H	70	30	Frequently offshore
Little Egret	2	1		H	40	60	
Oystercatcher	50	20		H	5	95	
Curlew	40	40	✓	H	5	95	
Grey Plover	3	1		M	10	90	
Golden Plover	2000	300	✓	M	5	95	Interchange with bay roost
Lapwing	100	25		M	10	90	
Redshank	30			H	20	80	
Dunlin	150	50	✓	H	60	40	

Roost site habitat, substrate composition, other features (%)		Further description and notes
Saltmarsh	70	OS Grid ref: SS 451 306 Estimated roost area: 1000m^2 Big tides can inundate roost completely
Water	10	
Mud	10	
Sand	10	

Disturbance at the Skern high tide roosts

3.4.28 There is currently surprisingly little disturbance at the Skern high tide roosts, especially considering the site's popularity and access arrangements. Walkers, often with dogs off the lead are the main concern and can flush both roosts if venturing out onto intertidal and foreshore areas, a fortunately infrequent occurrence in the north of the bay. However, when this does occur, disturbance is often significant as dogs may actively chase birds or be encouraged into the water. Activity on the backshore appears to have little effect on roosting or feeding birds.

3.4.29 Disturbance is more of an issue during the flooding tide when walkers may be more likely to use the foreshore, particularly in the vicinity of the Pill roost (Figure 24). Deep cuts in the saltmarsh in the north of the bay appear to form an effective barrier to most walkers that might think to walk out beyond the strip of beach.

Figure 24. Walkers with dogs off the lead flush feeding Wigeon on the low tide SWCP route between Appledore and Skern

3.4.30 Waterborne traffic is not an issue in winter due to the shallow nature of the bay, and although it could conceivably be explored by kayak, stand-up-paddleboard (SUP) or similar, this does not currently appear to occur. Such activity at high tide would be likely to cause significant disturbance to the high tide roosts if the shoreline was approached.

Potential management and mitigation for the Skern high tide roosts

3.4.31 There is management in place at Northam Burrows Country Park that has benefited wintering waterbirds using the Skern. Most significantly, a ban on flying model aircraft that used to be a popular activity in the area and would cause disturbance to birds.

3.4.32 The site may benefit, especially if visitor numbers increase, from some targeted management, signage and interpretation as follows:

- Encouraging the use of the high tide SWCP route at all times.
- Dogs on leads on the low tide SWCP route.
- Interpretation boards at entrance points and in the carpark highlighting the bird interest and requesting the intertidal area is not accessed.

Sector 11490 White House to Airy

3.4.33 This sector covers the estuary mouth and the northern shores, ending at the mouth of the Taw. The sector is predominantly sandy beach at high tide with saltmarsh and mudflats behind the shelter of Crow Point, a sandy spit at the

eastern end of the sector (Figure 25). At low tide, extensive sandbanks and bedrock interspersed with pools are exposed on the shoreline opposite Skern.

Figure 25. Aerial photo of sector 11490 (red boundary), the high tide roosts (white boundary and lines) within it and surrounds.

3.4.34 The White House to Airy sector is historically thought to have held four high tide roosts, although only three are detailed here. A roost at Airy Point has not been observed in the previous two years of WeBS counts, and incidental observations of the area this winter throughout the course of disturbance surveys at Westward Ho! (see Section 5) have confirmed the lack of any consistent high tide roost at this site, although Cormorants and Oystercatchers may roost here at times throughout the tidal cycle.

3.4.35 The Airy Point area is, however, of particular importance to feeding Sanderling (R. Jutsam, *pers comm.)* and the intertidal area between Airy Point and Crow Point is also a very important feeding area at low tide for a wide range of WeBS species, with Oystercatcher tending to be most numerous.

3.4.36 Due to their proximity to one another, similarity in disturbance issues, and the potential to implement management and mitigation for all sites concurrently, the Crow Point high tide roost sites are considered together in the discussion regarding disturbance and any mitigation required below.

Crow Point Saltmarsh high tide roost

3.4.37 A range of species (Table 10) predominantly use a small area of salt marsh intersected by muddy creeks, but also a patch of shingle at the southern end of the marsh and some of the sandy surrounds, all within a bay protected by the sand dunes of Crow point and the southern edge of Braunton Burrows.

Table 10. Crow Point saltmarsh high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		Notes
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	
Oystercatcher	100	20		H	10	90	
Greenshank	1	0		L	20	80	
Redshank	25	5		H	20	80	
Curlew	160	20	✓	H	5	95	
Wigeon	100	40	✓	M	50	50	
Mallard	60	20	✓	M	50	50	
Ringed plover	50	10	✓	M	100	0	Use shingle and sand.
Knot	5	0		L	0	100	
Black tailed godwit	10	0		L			Rare
Dunlin	10	0		L	70	30	
Little egret	2	1		H	80	20	

Roost site habitat, substrate composition, other features (%)		Further description and notes
Sand	30	OS Grid ref: SS 465 323 Estimated roost area: 2000m^2
Saltmarsh	20	
Water	50	

3.4.38 Due to the shelter from westerly and northerly winds, bird numbers at the roost tend to be higher during inclement weather with such wind directions, than in southerly or easterly winds, when the roost is exposed to the weather and may be deserted.

3.4.39 There tends to be movement of Oystercatcher and Curlew between this roost and the Crow Point beach roost. On very high tides the salt marsh can be almost completely flooded, compressing the roost into a small area, although under normal tidal conditions the roost will spread out over a much larger area if undisturbed.

Crow Point beach high tide roost

3.4.40 The roost that forms on the shoreline at the eastern tip of Crow Point is potentially one of the biggest Oystercatcher roosts on the TTE, with many hundreds of birds typically present (Table 11).

3.4.41 It is likely that counts here often under-estimate the number of Oystercatchers present due to the difficulties of observing the roost without disturbing it.

3.4.42 Other species use this roost regularly, though (Common) Ringed Plover *Charadrius hiaticula* and (Ruddy) Turnstone *Areneria interpres*, as on the nearby salt marsh, tend to utilise the area for feeding as the tide is falling.

Table 11. Crow Point beach high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Oystercatcher	1300	600	✓	H	5	95	Likely to be underestimated
Curlew	100			H	10	90	
Turnstone	10			L	100	0	On ebbing tide
Ringed Plover	40			M	100	0	On ebbing tide
Cormorant	5			M	0	100	
Roost site habitat, substrate composition, other features (%)				**Further description and notes**			
Sand			100	OS Grid ref: SS 467 320 Estimated roost area: 600m^2			

Crow Point groynes high tide roost

3.4.43 The roost site that covers the western beach from Crow Point to the groynes is heavily weather dependent and appears to be abandoned when the wind is westerly to northerly.

3.4.44 When used, gulls tend to dominate (Table 12) and usually roost at the southern end towards Crow Point, while waders may use the entire length of beach.

Table 12. Crow Point groynes high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Black-headed Gull	500				0	100	
Herring Gull	150				0	100	
Lesser Black-backed Gull	10				0	100	
Great Black-backed Gull	2				0	100	
Common Gull	5				0	100	
Curlew	20				5	95	
Sanderling	20				90	10	
Dunlin	20				90	10	
Ringed Plover	40				90	10	
Roost site habitat, substrate composition, other features (%)				**Further description and notes**			
Sand			90	OS Grid ref: SS 463 321 Estimated roost area: 1000m^2			
Rock			5				
Man-made structure			5				

Disturbance at the Crow Point high tide roosts

3.4.45 Easy access to the sector as a whole from the large car park at the end of the toll road at the White House, and at nearby Sandy Lane within Braunton Burrows contributes to heavy use of the area for a range of recreational activities. However throughout the winter period, walkers, many with dogs off the lead, are most frequent and numerous user group.

3.4.46 Over 200 hundred cars a day use the toll road, at a cost of £2, all of which will park at the Crow Point car park. Since introducing comparatively expensive winter parking charges at Saunton Sands and Sandy Lane, the toll road and car park have become much busier (M. Coleman, WeBS counter, *pers comm*.).

3.4.47 Not all walkers from the car park access the foreshore, with some preferring to follow tracks across Braunton Burrows, especially in poor weather. However, recent fencing and access restrictions on Braunton Burrows is thought to have increased the numbers of walkers using the foreshore. Nevertheless, the lack of a circular walk around Horsey Island since the breach, may have increased pressure from walkers on Braunton Burrows and the estuary foreshore

Figure 26. The Crow Point Oystercatcher roost at dawn containing ca.1,000 birds (top, not all birds shown) is flushed by the first dog walkers of the day (bottom).

3.4.48 A particularly popular circular walk from the White House car park can take walkers past some, or all, of the high tide roost locations. Walkers leaving the car park can access the foreshore, walk toward the saltmarsh area, then round Crow Point, or cut through the dunes onto the estuary mouth foreshore to walk along the sandy beach to the groynes, before returning through the dunes and the core Braunton Burrows area.

3.4.49 Most walkers stay on the beach fringing the salt marsh, reducing the potential for disturbance, though some will cross the marsh, thereby flushing birds. Walkers frequently round Crow Point itself, invariably flushing any roosting birds (Figure 26). The beach between Crow Point and the groynes is also popular.

3.4.50 Disturbance to all high tide roosts in the sector is most often caused by free running dogs. Some dogs might actively pursue birds, others may be retrieving balls thrown for them over the saltmarsh or into the water.

3.4.51 Disturbance during daylight hours is frequent and, assuming it did not prevent a roost forming in the first instance, often results in the roost sites being abandoned by all wader species. Collection of driftwood may also take walkers onto more sensitive areas in the vicinity of the roosts.

3.4.52 The bay behind Crow Point offers protection from westerly winds and this is exploited during the summer with the southern end to Crow Point being used extensively as an anchorage, although most of these craft have left by mid-September. A small number of boats remain at moorings within the bay throughout winter, but most are in front of Horsey Island. All are rarely attended to but vehicles may be driven onto the beach when they are.

3.4.53 A slipway by the White House is very rarely used in winter, although small numbers of windsurfers and kite surfers infrequently launch in this area. They have not been observed causing disturbance to the roosts and tend to be some distance away. The groynes area may be utilised for surfing at high tide, which could disturb roosting birds, though this appears to be relatively rare.

3.4.54 General vessel traffic, under sail or power, is very light throughout winter. However, periods of good weather in October may see the Crow Point area used as a base for water skiers, and the shoreline as far as Heanton is designated as a water ski area on the North Devon Biosphere “Estuary Code of Conduct” interpretation signage. Fishing from boats is most likely on the western shoreline in winter, but unlikely to disturb roosting birds.

3.4.55 Anglers on the shoreline are infrequent and usually avoid high tide periods, reducing the potential for conflict with roosting birds.

3.4.56 Mountain bikers use the Braunton Burrows area but will tend to avoid intertidal habitat and soft ground for obvious reasons. The (illegal) use of motorised vehicles such as motorbikes or quads in the area occurs infrequently but does have the obvious potential to disturb the high tide roosts.

3.4.57 When disturbed, Oystercatchers roosting in this sector tend to flush to the Black Ground roost at Instow, though smaller numbers may head towards Skern. Curlew are more likely to fly east upstream along the Taw. Wigeon and Mallard flushed from the saltmarsh will tend to linger offshore, returning to the saltmarsh shoreline when they perceive it is safe to do so.

Potential management and mitigation for the Crow Point high tide roosts

3.4.58 Despite the site's profile, there is currently very little management or mitigation in the area. A generic Natural England branded sign is not well sited as it is almost hidden in the dunes on the backshore between the car park and the salt marsh (Figure 27) and is being too easily missed by walkers on the foreshore. Critically, no particular area is specified. The general advice to keep dogs under close control is considered vague and inadequate.

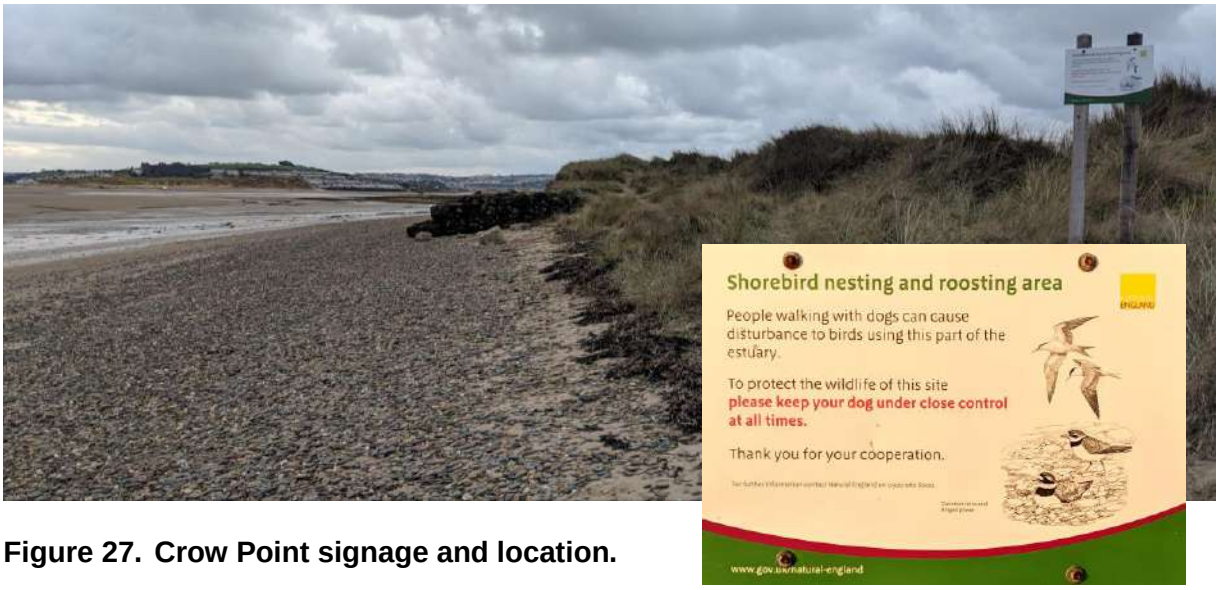

Figure 27. Crow Point signage and location.

3.4.59 The following measures are suggested:

- An on-site wardening presence would be in-keeping with the wider site status. Braunton Burrows itself is a UNESCO Biosphere reserve and is under pressure from ever increasing visitor numbers.
- Signage should be properly sited at major access points to the foreshore with specific, justified advice related to mapped areas.
- Increasing the price of the toll road could reduce visitor numbers in this area.

3.4.60 The Crow Point roost is, historically, the most important in this sector but is currently considered too prone to disturbance to exist in any meaningful capacity during daylight hours.

3.4.61 At present, it could be argued that the Oystercatchers that would roost here can be accommodated on the Skern and at Instow, although these roosts may not allow for much future expansion of the estuary population and may not be available during very high tides. The Instow roosts in particular are also prone to disturbance.

3.4.62 The creation of a voluntary or enforced no-go zone on Crow Point itself around high tide (but preferably throughout the tidal cycle) is thought to be an easily implemented and monitored pilot project to gauge the public response and the potential effectiveness of such measures.

Sector 11493 Saunton Sands

3.4.63 Saunton Sands is a long sandy beach running north from the mouth of the estuary to Downend Point in the north. The sector is bound by extensive sand dunes and the Braunton Burrows SAC at the eastern boundary.

3.4.64 The site is extremely popular and very busy on a daily basis. A range of recreational activities are popular here throughout the winter, including walking, dog walking, jogging, surfing and kite surfing.

3.4.65 Saunton Sands is the estuary's primary site for Sanderling and can also be important for Ringed Plover. Cormorants often roost at the southern end of the beach and can be numerous at any state of tide, sometimes accompanied by Oystercatchers. However, there is no consistent high tide roost in this locality.

Figure 28. Aerial photo of sector 11493 (red boundary) and surrounds.

Potential management and mitigation at Saunton Sands

3.4.66 Despite the lack of a high tide roost, it is suggested that management of the site is considered to offer some protection to the Sanderling that rely on the beach for foraging, and are frequently disturbed here (R. Jutsam, WeBS counter, *pers comm*, and see Figure 29).

3.4.67 Any interpretation in the area could map the southern end of Saunton Sands and the Airy Point area as important for birds, with the suggestion that it is avoided by recreational users. Emphasis might be placed on specifically avoiding the shoreline, as this is the primary habitat utilised by Sanderling.

3.4.68 Any pamphlet for distribution to estuary users that includes high tide roost mapping could also include guidance on important foraging areas such as this.

Figure 29. A free-running Red Setter pursues Sanderling at Saunton Sands © Rob Jutsam.

Sector 11496 Braunton Marshes

3.4.69 This sector is something of an anomaly, being comprised completely unimproved and improved grassland managed for agricultural grazing (Figure 30). A series of drainage ditches and natural creeks cover the sector.

Figure 30. Aerial photo of sector 11496 (red boundary), the high tide roosts within it (white boundaries) and surrounds.

3.4.70 Technically, there is no consistent high tide roost within the Braunton Marshes WeBS sector boundary. However, while conducting interviews and gathering data, it became apparent that the counters of this sector and the adjacent River Caen and Horsey Island sector have used the toll road as the sector boundary.

3.4.71 The high tide roost and associated data that is actually outside the Braunton Marshes WeBS sector is presented here as being within it, in keeping with the WeBS data as gathered and entered into BTO databases.

Braunton Marsh high tide roost

3.4.72 A Lapwing roost (Table 13) forms on fields adjacent to the toll road at high tide. One or all of three fields are consistently used (Figure 30), with the roost location being dependent on the ambient temperature.

3.4.73 In warmer conditions, the roost forms in the vicinity of the White House, with two fields being preferred, although some neighbouring fields may also hold lesser numbers of birds. In colder conditions (0-2 ^{o}C), a field opposite the northeast corner of Horsey Island is used.

3.4.74 The numbers of Lapwing roosting here have declined substantially, with the WeBS counter estimating a reduction of 30% in the past five years and 70% in the past 10 years. Golden Plover and Curlew also use the roost fields, and others within and bordering the sector, predominantly for foraging.

Table 13. Braunton Marsh high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Lapwing	1000	200-400	✓	M	20	80	Long term decline
Roost site habitat, substrate composition, other features (%)				**Further description and notes**			
Grazed field			100	OS Grid ref: SS 468 331 OS Grid ref: SS 478 344 (cold weather roost) Estimated roost area: highly variable			

Disturbance at the Braunton Marsh high tide roosts

3.4.75 Disturbance on these roost sites is not perceived to be a problem. There is no public access and the fields are fenced and gated to retain livestock. Vehicular traffic on the toll road and pedestrian traffic on the raised inner bank path around Horsey Island does not appear to directly disturb birds, although may structure their use of specific fields at times.

Potential management and mitigation for the Braunton Marsh high tide roosts

3.4.76 There is currently no requirement for management and mitigation at this high tide roost from the perspective of recreational disturbance. However, it is of note that anecdotal observation suggests that a change in land use, from a traditional grazing regime to a more intensive approach has reduced the value of these fields to foraging Lapwing (M. Coleman, *pers. obs*.).

Sector 11497 River Caen and Horsey Island

3.4.77 This sector encompasses an interesting variety of habitat including agricultural grazing land, a large and recently created tidal lagoon, the River Caen and an area of foreshore comprised of sand, mud and stone substrates. Up-to-date aerial photography is not available to show that the green island bound by a river to the east, beach to the south and flooded fields to the west (Figure 31) is now intertidal habitat.

3.4.78 Horsey Island is now the true focal point of the sector, where several years of tidal flooding and drainage issues followed by a major breach of the sea wall in 2017, have seen the site transform from reclaimed grazing land to a tidal lagoon with saltmarsh and mudflats becoming established therein. A toll road runs through the site along the inner sea wall boundary of Horsey Island, which terminates at a large car park.

Figure 31. Aerial photo of sector 11497 (red boundary), the high tide roosts within it (white boundaries) and surrounds.

3.4.79 Three discrete high tide roosts can now be found in the sector during the winter. However, the data presented here only relates to recent observations and it is clear that use of the area by wintering birds will be dependent on future changes in what is highly dynamic habitat.

Horsey Island White House high tide roost

3.4.80 A high tide roost (Table 14) forms at the western end of Horsey Island on a raised area where the sea wall path terminates at the White House boundary (Figure 31). This roost currently appears to be very consistently used, but has only recently been established, so species composition data may not be accurate or representative and is expected to change along with the habitat.

3.4.81 From anecdotal observations, roost site usage currently appears to be higher during afternoon and evening high tides (M. Coleman, *pers. comm*).

Table 14. Horsey Island White house high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 1-year WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Brent Goose	46		✓	M			
Shelduck	52			H	50	50	
Wigeon	30			M			
Teal	20			M			
Curlew	25			H		100	
Dunlin	20			M		100	
Golden Plover	2800		✓	M			
Lapwing	1300		✓	M			
Ruff	4			M		100	
Greenshank	8		✓	M		100	
Black-tailed Godwit	42		✓	L			
Redshank	40			H		100	

Roost site habitat, substrate composition, other features (%)		Further description and notes
Mud	80	OS Grid ref: SS 470 331 Estimated roost area: 800 m^2 Habitat is not established
Shingle	10	
Saltmarsh	10	

Disturbance at the Horsey Island White House high tide roost

3.4.82 The high tide roost forms near and adjacent to the Horsey inner bank footpath, especially at higher tides. This path can be busy in good weather, although the lack of a circular route around Horsey Island since the breach had considerably reduced usage. However, improvements to the inner bank footpath surface by the addition of compressed scalpings (stone or bitumen chips) has increased usage once more. Walkers on this path are highly likely to flush the roost as they are highly visible and in close proximity.

3.4.83 Wildfowling takes place quite frequently on Horsey Island in winter and the movement of people and dogs and noise from the guns can also flush the roost.

Potential management and mitigation for the Horsey Island high tide roost

3.4.84 Due to the current embryonic state of the habitat and the potential for it to change rapidly over time, monitoring of this roost would be the most appropriate management approach. This could be undertaken during WeBS counts. The potential development of this roost site would also benefit from being considered in the long-term management of Horsey Island.

3.4.85 Diverting the footpath off the top of the sea wall or providing adequate screening (which could even incorporate a hide) would reduce disturbance to the roost, which in turn, may encourage its continued and expanded use by WeBS species.

Horsey Island Pills mouth high tide roost

3.4.86 A high tide roost (Table 15) forms on a promontory of rock and saltmarsh near the mouth of the River Caen on the seaward side of the Horsey Island outer sea wall (Figure 31).

Table 15. Horsey Island Pills mouth high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		Notes
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	
Turnstone	30	20	✓	H		100	
Oystercatcher	15	10		H		100	
Dunlin	250	200	✓	H		100	
Cormorant	3			L		100	
Wigeon	50			M	90	10	
Grey Plover	20			M	20	80	
Lapwing	200			L		100	

Roost site habitat, substrate composition, other features (%)		Further description and notes
Saltmarsh	50	OS Grid ref: SS 483 335 Estimated roost area: variable
Rock	30	
Shingle/sand	20	

Disturbance at the Horsey Island Pill mouth high tide roost

3.4.87 Disturbance at the roost has been much reduced since the breach of the sea wall and subsequent closure of the footpath. Some walkers still access the area from the toll road car park, but numbers are low, with high tide being even less popular due to the lack of beach for dogs to run free on. Use of the area for angling has also reduced, and although bait digging still occurs daily on the intertidal between the roost site and the White House, this does not occur at high tide.

3.4.88 Information on the waterborne disturbance events at the nearby Heanton to Caen sector roosts is also applicable here.

Potential management and mitigation for the Horsey Island Pill mouth high tide roost

3.4.89 Preservation of the current situation is considered to be the best management approach, coupled with maintenance or improvement of the present signage informing walkers that the footpath around the outer bank of Horsey Island is closed due to safety concerns arising from the breach in the outer sea wall.

Horsey Island fields high tide roost

3.4.90 A high tide roost (Table 16) forms on areas of higher ground on flooding fields amongst the old field boundaries (Figure 31). The habitat here is still in an embryonic state with some evidence of succession to saltmarsh in places and establishment of mudflats in others.

3.4.91 Particularly high tides can flood the area completely and preclude the formation of a high tide roost, although otherwise the site currently appears to be consistently used.

Table 16. Horsey Island fields high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 1-year WeBS core counts			Fidelity	Typical behaviour		Notes
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	
Shelduck	70		✓	H			
Wigeon	40		✓	M			
Teal	80		✓	M			
Lapwing	1500		✓	M			Also roost here at low tide
Golden Plover	3000		✓	H			Also roost here at low tide
Curlew	60		✓	H			
Black-tailed Godwit	15		✓	L			
Ruff	4			M			
Dunlin	200		✓	M			
Redshank	70		✓	H			
Greenshank	15		✓	M			

Roost site habitat, substrate composition, other features (%)		Further description and notes
Mud	80	OS Grid ref: SS 479 337 Estimated roost area: 2500 m^2 Habitat is not established
Shingle	10	
Saltmarsh	10	

Disturbance at the Horsey Island fields high tide roost

3.4.92 This roost is currently well insulated from disturbance. The old field boundaries provide good cover, although it is likely that these will eventually erode.

3.4.93 Wildfowling on Horsey Island takes place quite frequently in winter and can flush the roost.

Potential management and mitigation for the Horsey Island fields high tide roost

3.4.94 Due to the embryonic state of the habitat and its propensity to change in the future, monitoring of this roost during WeBS counts is seen to be the most appropriate management approach. The potential of this roost site to develop further is best considered in long-term management planning for Horsey Island.

Sector 11483 Isley Marsh to Instow

3.4.95 This sector is bordered on the landward side by the SWCP that re-joins the Tarka Trail at Isley Marsh.

3.4.96 The available habitat is dominated by intertidal rock, interspersed with mud and sand. The former site of the old Yelland power station is a major feature structuring the nature of the available habitat as a result of attendant jetties and a large outflow forming a creek that empties into the estuary.

3.4.97 To the east of the old power station site lies Isley Marsh, an RSPB reserve characterised by saltmarsh and mudflats. At low tide, extensive sandbanks are exposed in the estuary directly offshore (Figure 33).

Figure 32. Oystercatcher roost at the Black Ground during a spring high tide.

3.4.98 The sector is a relative 'hotspot' for high tide roosts on the TTE, with three major high tide roosts amongst four locations that consistently hold large numbers of a wide range of WeBS species, but especially Oystercatcher (Figure 32).

Figure 33. Aerial photo of sector 11483 (red boundary), the high tide roosts within it (white boundaries) and surrounds.

Isley Marsh high tide roost

3.4.99 Isley Marsh is an RSPB reserve comprising intertidal saltmarsh and mudflats on the southern shore of the River Taw, opposite the mouth of the River Caen (Figure 33). The reserve holds a significant high tide roost comprised of a range of waterbirds (Table 17), and is of known importance for feeding and resting waders and wildfowl.

3.4.100 Wigeon and Teal tend to use the eastern side of the reserve, keeping to the water or saltmarsh edge for feeding and roosting, whereas waders favour the western side.

3.4.101 The site is particularly important for Curlew and is probably the second most important roost on the TTE after Horsey Island for Greenshank *Tringa nebularia*. However, Dunlin numbers have declined significantly in recent years, reflecting an estuary wide trend.

3.4.102 The Isley Marsh roost is often used by birds that have been disturbed from roosts elsewhere in the estuary, and arrivals from Chivenor Bank and the nearby Yelland and Instow roosts can be readily observed in relation to disturbing activity at those sites.

Table 17. Isley Marsh roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Wigeon		200	✓	H	90	10	Use eastern side of reserve
Teal		100	✓	H	90	10	Use eastern side of reserve
Spoonbill	10	6	✓	H		100	Principal high-tide roost site
Greenshank	17	3	✓	M		100	
Redshank	35	6		H	30	70	Generally small numbers
Curlew	c.200	40-60	✓	H		100	Principal high-tide roost site
Little Egret	28	6	✓	H		100	
Grey Heron	6	1	✓	H		100	
Snipe	75			U			Impossible to accurately assess
Black-tailed Godwit	10	0		L		100	
Dunlin	20	2		L		100	Severe declines

Roost site habitat, substrate composition, other features (%)		Further description and notes
Saltmarsh	80	OS grid ref: SS 490 330 Estimated roost area: 8,000 m^2
Mud	10	
Water	10	

Disturbance at the Isley Marsh high tide roost

3.4.103 Isley Marsh is one of the most secure and least disturbed high tide roost sites on the TTE, being largely screened by vegetation fringing the adjacent footpath. A well-sited viewing point with a bench is at sufficient distance from the usual roost area. Only birds feeding along the shoreline or on the water below the bench are prone to disturbance, with these normally flying further into the reserve towards the roost site.

3.4.104 Disturbance is most acute during the very highest spring tides when birds are pushed towards the reserve boundary adjoining the Tarka Trail where the numerous passing walkers, dogs, joggers and cyclists can cause the roost to flush. During normal or neap tidal conditions, the main sources of disturbance come from infrequent raptors, mainly Peregrine Falcon *Falco peregrinus*, (Eurasian) Buzzard *Buteo buteo*, (Western) Marsh Harrier *Circus aeruginosus*, and Osprey *Pandion haliaetus* (on spring and autumn passage).

3.4.105 Critically, there is no reasonable route that walkers could routinely utilise in the vicinity of the usual roost area. However, walkers accessing the foreshore from the SWCP, especially those with dogs off the lead, can cause major disturbance events. This is currently a relatively rare occurrence.

3.4.106 The actuality of, and potential for, disturbance to roosting birds at the site has certainly increased in recent years, particularly due to growing numbers of dog walkers using both the Tarka Trail and the circular walk around the SWCP to Instow. However, most dog walkers tend to cut across the wide area of grassland between Isley Marsh and the old power station site, avoiding the path past Isley. This brings its own issues though, particularly for the ground nesting passerines attempting to breed there in spring.

3.4.107 The most prominent, and recent potential source of increased disturbance is the recent construction of a major access path from the new homes built in Yelland to the Tarka Trail, nearly directly opposite the access gate to Isley Marsh. This path could potentially substantially increase numbers of visitors, many of which will inevitably be exercising dogs, at the reserve. It is suggested that careful monitoring and management of the site will become increasingly important.

Potential management and mitigation for the Isley Marsh high tide roost

3.4.108 The current RSPB signage does little more than indicate their ownership of the reserve, and vaguely marks the western boundary. The recent addition of a small, rather poorly maintained noticeboard with recent bird sightings alongside the gate off the Tarka Trail, could be considered a wasted opportunity for more comprehensive interpretation.

3.4.109 Signage could stress the importance of Isley Marsh as a roost site for passage and especially wintering birds and urge dog-walkers to keep their dogs off the foreshore on the entire path around to Instow. This may be best achieved with a clear map of ‘no-go’ areas. A sign on the gate indicating that dogs should be kept

on leads was removed many years ago, and never replaced. Further potential management and mitigation could include:

- Provision of a bird hide with screening at the current viewing point with bench.
- Screening or stock fencing of the SWCP running west from the view point.
- Signage and interpretation at the viewing point.
- Dogs on leads rule at the RSPB reserve, with this being clearly signed and its rationale explained.

3.4.110 Until recently, there was a very clear sign at Home Farm Marsh, immediately to the east of Isley marsh indicating that there is no permitted access along the sea wall to Isley Marsh. This urgently needs renewing as despite the three entry points along the Tarka Trail to Home Farm Marsh displaying 'No Dogs' signage, dog-walkers and their dogs, invariably off the lead, can be encountered.

Yelland Roost

3.4.111 Despite its relatively small size in comparison to other high tide roosts on the estuary, the location of Yelland roost at the blunt end of a small west-facing promontory (Figure 33) gives it an importance that belies its size, as shown by the range of species that gather there from early autumn until early spring (Table 18).

Table 18. Yelland Roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Wigeon	125		✓	H	75	25	Feed in power station outlet
Teal	80		✓	H	75	25	Feed in power station outlet
Oystercatcher	600+		✓		0	100	
Curlew	100+		✓	H	10	90	
Grey Plover	80		✓	H	0	100	Principal high-tide roost
Black-tailed Godwit	10			M	0	100	
Bar-tailed Godwit	40			M	0	100	
Ringed Plover	40			M	0	100	
Lapwing	100+		✓	H	0	100	
Dunlin	150		✓	H	40	60	
Knot	30	0-5		L	0	100	Passage birds
Turnstone	45		✓	H	90	10	
Greenshank	8			M	0	100	
Redshank	20		✓	H	20	80	
Snipe	10		✓	H	10	90	
Cormorant	3			H	0	100	
Little Egret	6			H	0	100	
Grey Heron	2			H	0	100	

Roost site habitat, substrate composition, other features (%)		Further description and notes
Saltmarsh	65	OS Grid ref: SS 478 324 Estimated area: 300 m^2
Mud	15	
Rock	15	
Water	5	

3.4.112 Most of the wader species (Table 18) use the site to rest, although a few species, especially Turnstone, feed there, while Wigeon and Teal are usually found roosting on the foreshore or feeding in the old power station water outlet.

3.4.113 Yelland roost is a 'go-to' roost for birds disturbed from high-tide roosts at Crow Point (especially Oystercatchers), The Black Ground and Cool Stone at Instow (mixed waders), and from along Chivenor bank (waders and wildfowl).

Disturbance at the Yelland high tide roost

3.4.114 The main source of disturbance to the roost is walkers, mainly with their dogs, which can cause the roost to flush when they veer off the SWCP to traverse the saltmarsh or more usually (and easily) the open rocky area between the vegetation and the shoreline. In general, roosting birds will sit 'tight' (shuffling as close to the shoreline as possible) when walkers, joggers, dogs and the occasional solitary birdwatcher pass by on the coast path. Most walkers coming from the direction of Instow out on the foreshore with their dogs, that may also encroach into the water, tend to turn back before reaching an old sewage outlet (which was a regular roost for 50+ Turnstones in the late 1970s), thus avoiding disturbance to the roost. It seems highly likely that more walkers will continue past this point if Yelland Quay is developed.

3.4.115 Wigeon and Teal on the water in the old outlet channel or grazing the vegetation of the southern shoreline of the channel, will move towards and sometimes onto the main roost area when people and dogs pass by, but gradually return afterwards. The occasional bait digger in the muddy area between the roost and the old power station quay will also put birds up, depending on how close an approach to the roost is made. In these instances, birds are unlikely to return.

3.4.116 Small motorised boats, sometimes with anglers, passing close by the roost will also flush birds. Given its more discreet location, and in part thanks to the protection afforded by the old power station outlet, the frequency of disturbance appears to be relatively low compared to The Black Ground and Cool Stone roosts nearer to Instow.

3.4.117 When disturbed from the Yelland roost or pushed off by spring tides, all, or most Curlew will move upstream to Isley Marsh, together with small numbers of Redshank, Greenshank and Little Egret. If not too disturbed, Oystercatcher, Grey Plover, and Bar-tailed Godwit are more likely to circle around and return to the roost while Ringed Plover, Dunlin, Knot and Turnstone will move across the estuary to Horsey Island or perhaps the small saltmarsh roost inside Crow Point. The latter action is however becomingly increasingly unlikely due to increased levels of disturbance at that site.

Potential management and mitigation for the Yelland high tide roost

3.4.118 With the potential for increasing disturbance due to significantly increasing levels of SWCP traffic and the long-planned redevelopment of the Yelland Power station brownfield site, management and mitigation at this roost site should be considered

a priority. Two easily implemented, complementary and cost-effective options to protect this roost are:

- Information boards showing the roost site and the birds present, and a suggested 'no go' zone (either voluntary or enforced) around it. Boards could be situated at or near the concrete bridge over the defunct water outlet from the old power station, and at, or near, the point where the path crosses the track from the business park to the old quay.
- Screening or fencing along a section of the SWCP to prevent easy access to the foreshore in the vicinity of the roost area.

The Black Ground and Cool Stone high tide roost

3.4.119 High tide roosts on these two rocky sites at the northern end of Instow beach (Figure 33) form on all except the very highest spring tides, when the whole area can be inundated. However, even during spring tides, small areas of rock usually remain exposed and are utilised by roosting Oystercatchers (Figure 32) and smaller numbers of other waders (Table 19).

3.4.120 Of the two sites, the Black Ground is used preferentially by birds and is invariably the first port of call for a majority of the Oystercatchers disturbed or excluded from their primary roost at Crow Point.

3.4.121 In fact, disturbance at Crow Point now appears to be so frequent that the Black Ground may have become the estuary's principal Oystercatcher roost, at least during daylight hours.

3.4.122 If birds are further disturbed and flushed from the Black Ground, they will move over to the Cool Stone area and settle there, unless disturbed again or pushed off by a spring tide.

Table 19. The Black Ground and Cool Stone high tide roost species composition, utilisation and habitat characteristics.

Species	**Estimated typical roost counts from previous 5 years WeBS core counts**			**Fidelity**	**Typical behaviour**		
	Max count	**Typical count**	**>5% of estuary population?**	**(% of visits present)**	**% Feed**	**% Rest**	**Notes**
Wigeon	60	20	✓	H	60	40	Use shoreline
Oystercatcher	900	400	✓	H	5	95	May feed on cricket pitch
Turnstone	40	5	✓	H	80	20	
Dunlin	150	20		L	20	80	
Ringed Plover	60	0-10	✓	L			
Curlew	80	40	✓	H	5	95	May feed on cricket pitch
Sanderling	8	0-5	✓	L			
Little Egret	6	1		M			

Roost site habitat, substrate composition, other features (%)		**Further description and notes**	
		Black Ground	**Cool Stone**
Rock	95	OS Grid ref: SS 473 315 Estimated roost area: 500 m^2	OS Grid ref: SS 473 318 Estimated roost area: 400 m^2
Water (channels and pools)	5		

Disturbance at the Black Ground and Cool Stone high tide roost

3.4.123 Disturbance from walkers, dogs, joggers and anglers is frequent at this site. The Black Ground is most affected due to the proximity and ease of access from Instow beach.

3.4.124 The most frequently observed disturbance events are due to free-running dogs off leads chasing birds or running across the rocks, some of which are chasing balls thrown by their owners or running in and out of the water.

3.4.125 Levels of disturbance are frequent and occasionally severe as illustrated by the following recent observation from the sector's long serving WeBS counter, Tim Davis. "*In October 2018, I carried out my WeBS count on a Monday (instead of Sunday owing to poor weather conditions). I fully expected the sector to be quieter of people and dogs, but this proved not to be the case; at peak high tide that day, a large part of The Black Stone rocks were still uncovered, with upwards of 650 Oystercatchers, 5 Curlews, 2 Little Egrets, 35 Ringed Plovers, 40 Dunlins, 3 Sanderlings and some 30 Turnstones around the outer perimeter of the rocks. As I set up my scope to begin the count, walkers & dogs passed below me on the inward side of the intertidal rocks immediately next to the wall of Instow cricket ground. No sooner had I started to count than two anglers walked out onto the rocks heading for the area of rocks jutting furthermost into the water. Within seconds every bird was in the air. A small number of Oystercatchers flew upstream past Instow sands, some headed off towards the Skern while most flew over to Cool Stone where they settled along with all of the smaller waders, the Curlew and the egrets. The anglers fished off the rocks for about 5 minutes before moving on to the sand beach between the Black Ground and Cool Stone, where they fished from the shoreline. Five minutes later they headed for Cool Stone with the inevitable result, every bird rising and heading up the Taw towards Yelland roost. The area between Cool Stone and Yelland roost, mostly sandy shore east of the oil jetty is a favourite place for people to encourage their dogs into the water either with sticks or tennis balls; feeding or roosting birds are inevitably few and far between here*."

3.4.126 The number of dogs being walked on Instow Sands and around the SWCP to the Tarka Trail has increased year on year. Anecdotal observation suggests that disturbance levels to the roost, especially when at the Black Ground, have increased massively since the mid-1970s. (Tim Davis, *pers comm*.). Anglers and bait diggers are less frequent, but can cause as much, if not more, disturbance by being present on or near the rocky areas for longer than passing walkers, joggers and their dogs.

3.4.127 Small fishing boats, motorboats and jet-skis on the water at high tide through the winter months are comparatively rare and have a lesser potential to cause disturbance as they are usually well offshore for obvious safety reasons.

3.4.128 Aside from the movement of roosting birds between the Black Ground and Cool Stone, birds being pushed off the roost area will move in one of four directions: a small number move up the Torridge, some head over to the Skern, more may move across the estuary towards Horsey Island, but most will fly upstream to

Yelland roost, with some (Curlews in particular) carrying on to Isley Marsh as higher tides squeeze the available space at the Yelland roost.

Potential management and mitigation for the Black Ground and Cool Stone high tide roost

3.4.129 Any management and mitigation at Instow will need very careful consideration and public consultation, although a precedent has been set by the implementation of a restricted area excluding dogs from the southern end of the beach from May to September. It should be noted that there is significant and ongoing public opposition to this restriction.

3.4.130 It is unfortunate that the dog restriction was not applied to the northern end of the beach and extended throughout the year; although it is understandable as the primary goal was to create an area of the main beach that could be utilised by beach users without dogs. However, a similar restricted area may be established in the winter at the Black Ground, Cool Stone and surrounding area to no real detriment of the vast majority of dog walkers using the site. It is likely that many of those dog walkers that do venture out onto these areas may be happy to modify their behaviour if properly informed of the reasoning behind the restriction.

3.4.131 Attempting to restrict access to any area of sand would require sensitive management and community engagement from the outset in order to mitigate the risk of mobilising opposition to such conservation-based efforts.

3.4.132 Instow beach may be considered to be a premier dog walking site, which in itself acts as something of a sink for this activity, thereby reducing pressure elsewhere. However, the site is now exceptionally busy and increasing user numbers may not be sustainable for much longer, potentially causing greater spillover to sensitive and bird rich areas nearby, such as the foreshore between Cool Stone and Yelland.

3.4.133 Eye-catching, long-lasting and well-positioned information boards at the point where Instow Sands meets the beginning of The Black Ground rocks, close to Instow cricket ground (perhaps even affixed to the cricket ground ‘wall’), and by the rough steps from the coast path down onto the sands above Cool Stone, might go some way to alleviating disturbance to these two important roosts by drawing attention to their importance and the impact of disturbance upon them.

3.4.134 Further management and mitigation options might include:

- A request for dogs to be kept on the lead in the area between the cricket club and the first jetty.
- An exclusion zone (either voluntary or enforced) incorporating the Black Ground and Cool Stone intertidal areas that includes the sands and mudflats between. This would create a substantial area for a variety of wintering waterbirds to feed and roost throughout the tidal cycle.

Sector 11488 Heanton to Caen

3.4.135 This sector incorporates the eastern bank of the River Caen, joining the estuary shoreline around Royal Marines Barracks at Chivenor. The SWCP runs behind

Chivenor airfield, although there is also a public footpath running along the eastern bank of the Caen, which terminates at the south west corner of the airfield site. On the seaward side of the base's flood defence wall there is a sand, mud and stone shoreline with sections of saltmarsh interspersed along its length, although this is most prominent at each end. As the Taw turns sharply to the north at the eastern end of this sector to round Penhill Point, there are extensive sandbanks known as Chivenor Ridge, that can be accessed from this area at low tide (Figure 34).

Figure 34. Aerial photo of sector 11488, high tide roosts (red boundary), the high tide roosts within it (white boundaries) and surrounds.

3.4.136 There are two important high tide roosts in the Heanton to Caen sector, both on the shoreline to the south of Chivenor airfield (Figure 34).

3.4.137 In addition to the high tide roosts, the whole foreshore between the mouth of the Caen and Chivenor point roost is an extremely important feeding area and one of the first to be exploited as the tide falls. This makes the whole area of great importance to birds through all states of the tide (see Section 2).

3.4.138 Due to their proximity to one another, similarity in disturbance issues and the potential to implement management and mitigation concurrently, the Chivenor high tide roost sites are considered together in the relevant section relating to management below.

Chivenor Point high tide roost

3.4.139 A roost forms here on all except the very highest spring tides, when the whole point may be inundated. Although small, the roost has a disproportionately high value as it is currently far less disturbed than many others on the estuary.

3.4.140 Roosting birds (Table 20) usually cluster close to the sea wall above the strandline around an outflow pipeline where the beach is quite steep. The roost gathers on both sides of the pipeline (that is assumed to be defunct) but is usually more extensive on the western side.

Table 20. Chivenor Point high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		Notes
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	
Oystercatcher	120		✓	H	0	100	
Lapwing	120		✓	H	0	100	
Grey Plover	15		✓	H	0	100	
Ringed Plover	30		✓	H	10	90	
Dunlin	150		✓	H	10	90	
Redshank	20		✓	H	20	80	
Turnstone	10		✓	H	50	50	
Cormorant	20		✓	H	0	100	
Wigeon	100		✓	H	30	70	
Gull sp.	100			H		100	

Roost site habitat, substrate composition, other features (%)		Further description and notes
Saltmarsh	45	OS Grid ref: SS 498 338 Estimated roost area: 400 m^2 Pipeline runs across shingle
Shingle	30	
Mud	10	
Rock	10	
Man-made structure	5	

River Caen high tide roost

3.4.141 A high tide roost (Table 21) forms to some extent on most tides on the saltmarsh immediately below the seawall on the eastern shore of the mouth of the River Caen. The site is however entirely inundated on high spring tides.

3.4.142 The extent to which the high tide roost is used by birds is highly dependent on levels of disturbance from watercraft using the River Caen and from wildfowlers shooting over the flight pond immediately to the east of the roost.

Table 21. River Caen high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Oystercatcher	100		✓	H	0	100	
Lapwing	500		✓	H	0	100	
Grey Plover	20		✓	H	0	100	
Curlew	120		✓	H	0	100	
Redshank	50		✓	H	20	80	
Snipe	50		✓	H	10	90	
Cormorant	10		✓	H	0	100	
Wigeon	100		✓	H	50	50	
Roost site habitat, substrate composition, other features (%)				**Further description and notes**			
Saltmarsh			90	OS Grid ref: SS 495 337 Estimated roost area: 800 m^2			
Mud			10				

Disturbance at the Chivenor high tide roosts

3.4.143 Levels of disturbance are reported to have increased slightly over the time the current WeBS counter has been visiting the sector, despite the protection afforded by access restrictions to the MOD land at Chivenor, and the lack of a public footpath along the sea wall. Walkers, usually accompanied by dogs, will still venture out along the foreshore, and inevitably flush or disrupt roosting and feeding birds. To illustrate the impact of walking this section of foreshore, the roosts are flushed during every WeBS core count as it is impossible to make progress along the estuary without doing so.

3.4.144 Due in large part to the lack of access and resultant lack of other estuary users, wildfowling takes place regularly in this area throughout the shooting season, especially at the small flight pond just to the east of the River Caen roost where disturbance can be significant. The sound of gunshots, if carried by a westerly wind, can also flush the Chivenor Point roost.

3.4.145 Access is not restricted from the water, and although stand-up-paddle boarding is predominantly seen in the summer months, it can occur into autumn when the roosting birds may be flushed by paddlers close inshore at high tides. Motor boats and jet skis may also use the area, although are similarly rare in the winter period. However, if good weather persists into October water skiing and similar activities within the area denoted by the North Devon Biosphere Reserve Estuary Code of Conduct signage, can cause disturbance to the high tide roosts. Disturbance from water users, particularly those actually using the Caen, is most acute at the River Caen roost and is generally more of an issue in autumn and spring. The Caen is only navigable at high tide, concentrating potential disturbance events at the time a roost would be present.

3.4.146 Flying of model aircraft can take place on Chivenor airfield at weekends and if aircraft are flown out over the foreshore in the vicinity of the roost, the birds within it will be flushed. Actual air traffic is currently infrequent but subject to change.

3.4.147 If flushed, birds from the Chivenor Point roost tend to head towards the Isley Marsh and Yelland high tide roosts. Flushed birds from the River Caen roost also tend to fly across the estuary to the Isley Marsh and Yelland high tide roosts, though some may head to the Horsey Island area.

Potential management and mitigation for the Chivenor high tide roosts

3.4.148 As it stands, there is little need for any management and mitigation to protect the Chivenor roosts. However, it should be noted that this is the only part of the core estuary area that does not have easy or established public access for dog walking and other land-based recreation.

3.4.149 The biggest long-term threat to the important feeding and roosting areas along the foreshore would be the closure of RMB Chivenor and any subsequent development for housing, commercial or industrial use. In this event, it is likely that there will be significant pressure to improve public access and 'open-up' this part of the estuary.

3.4.150 The announcement that the base is to be retained for the foreseeable future has reduced the prospect of increased disturbance of birds, although alongside an overall reduction in the defence estate, it is necessary to be mindful of any possible intensification of military use of the base.

3.4.151 Now is the time to be formulating conservation-led responses to any eventualities. Very careful planning would be required to minimise any harmful effects of any development in this area on wintering birds. At this stage, the requirement for significant setback and the exclusion of walkers and dogs from the foreshore would seem to be in obvious conflict with housing development.

3.4.152 Signage discouraging access to the foreshore, sited both at Chivenor industrial estate and at the 'dead end' of the footpath along the bank of the River Caen, may go some way to alleviating the current increase in pressure from walkers, and help preserve this section of the estuary shore.

Sector 11482 Fremington to Isley

3.4.153 To the east of Isley Marsh, this sector incorporates Home Farm Marsh, a reserve managed by the Gaia Trust, as well as the estuary shoreline to Fremington.

3.4.154 The estuary shoreline comprised of a mix of sand, rock and mud, is mostly inundated at high water and benefits from being remote from the Tarka Trail, which runs between 200 m and 700 m inland.

3.4.155 Two high tide roosts congregate on the shores of the Home Farm Marsh reserve, at the eastern and western ends (Figure 35).

3.4.156 The Home Farm Marsh high tide roost sites are considered together in the section relating to management and mitigation below as a result of their proximity to one another, similarity in disturbance issues and the potential to implement management and mitigation for both sites concurrently.

Figure 35. Aerial photo of sector 11482 (red boundary), the high tide roosts within it (white boundaries) and surrounds.

Home Farm Marsh NE high tide roost

3.4.157 A mixed roost (Table 22) forms near the Saltpill duck pond at high tide, with many birds then remaining in the area to feed on the mud exposed as the tide falls. This is the larger of the two roosts in this sector.

Table 22. Home Farm Marsh NE high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Oystercatcher	30	12		M		100	
Little Egret	3	1		M	20	80	
Lapwing	50	20		H		100	
Grey Plover	3	1		L		100	
Curlew	10	5		M	10	90	Declining
Redshank	100	20	✓	H	10	90	
Turnstone	14	8	✓	L	50	50	
Dunlin	20	5		L	50	50	
Wigeon	50	15		M	10	90	
Teal	20	6					
Shelduck	100	20	✓				February-March
Black-headed Gull	300	50					

Roost site habitat, substrate composition, other features (%)		Further description and notes
Saltmarsh	10	OS Grid ref: SS 510 332 Estimated roost area: 4500 m^2
Mud and silt	90	

Home Farm Marsh NW high tide roost

3.4.158 The western high tide roost gathers on rock and shingle. As the tide falls, rock covered with Bladderwrack *Fucus vesiculosus* is exposed, then giving way to mud and sand. The roost tends to host small numbers of a limited range of species (Table 23), although it does so on a regular basis. The level of use may be reduced by the proximity of the major roosts at Isley Marsh just to the west and Chivenor to the north, although some interchange is also likely.

Table 23. Home Farm Marsh NW high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Oystercatcher	50	10-20		H			
Curlew	5	12		M			Declining use
Lapwing	100	0-10		M			
Grey Plover	3	1		L			
Redshank	15	5		M			
Dunlin	32	10		L			
Turnstone	12	3		L			
Pintail	10	0		L			
Wigeon	200	<20		M			

Roost site habitat, substrate composition, other features (%)		Further description and notes
Rock	90	OS Grid ref: SS 492 234 Estimated roost area: 1000 m^2
Shingle	10	

Disturbance at the Home Farm Marsh high tide roosts

3.4.159 Access to the NW roost is via the Gaia Home Farm Marsh signposted trails, although direct access to the roost area by the general public is forbidden by the NO ACCESS sign. The WeBS counter for the sector reports that the signage appears to be effective and that he has never seen anyone else in this area. Nonetheless, staff on the site report occasional incursions by the public.

3.4.160 Although attempts have been made to restrict dog walking on the Home Farm Marsh reserve, this has not been successful. The site is only staffed on an *ad-hoc* basis of usually one day a week, and it is estimated that numbers of visitors, mainly walkers with dogs, have increased at least four-fold over the past 18 months (Rupert Hawley, warden, *pers. comm*).

3.4.161 The NE roost is easily accessed from the Tarka Trail and is therefore subject to greater levels of disturbance from dog walkers at high tide.

3.4.162 In recent years, stand-up-paddle boarding and gig rowing have become more popular and these activities can sometimes disturb the roosts. Boat traffic also occasionally ventures too close to the birds. Jet skis are only rarely evident.

3.4.163 When disturbed, birds from both roosts tends to move off to either the Isley or the Chivenor roost sites. Redshank are however more likely to fly into Fremington Pill.

Potential management and mitigation for the Home Farm Marsh high tide roosts

3.4.164 Increasing awareness of the high tide roosts amongst water users could reduce disturbance pressure in this sector. If stand-up-paddle boarders, gig rowers and other boat traffic could be encouraged to hold to the middle of the River Taw channel, this would make for less roost disturbance.

3.4.165 The eastern roost may benefit from signage identifying the roost area and attempting to restrict access. Training of volunteers at Home Farm Marsh to enforce dog walking restrictions or increased staffing of the site, could also help to enforce the attempted restriction of dog walking at the site.

Sector 11494 Barnstaple to Penhill

3.4.166 The Barnstaple to Penhill sector encompasses a range of intertidal habitat, but is dominated by Penhill Marsh itself, a large and relatively complex area of grazing marsh divided by several large creeks with many smaller tributaries.

3.4.167 At low tide, the sector also incorporates extensive exposed sand banks with minor channels. Penhill Point displays the most prominent sandbank, although on all but the smallest of tides, extensive sandbanks are exposed throughout the intertidal area.

3.4.168 To the east of Penhill Marsh, flood defences delineate the shoreline and abut intertidal sand and mudflats. A more prominent channel runs through the sandbanks here. To the east of the reinforced bank the shoreline reverts to marsh

either side of the Barnstaple New Bridge, although these areas are not grazed and are fringed by scrub (Figure 36).

3.4.169 The Tarka Trail runs along the edge of the sector and offers the only access points onto the intertidal area at Penhill Marsh and the flood defences. At the eastern end of the sector the Tarka Trail diverges away from the estuary with a gated access leading to a public footpath behind the marshes. There are also several well-worn small trails away from the actual footpath as well as historic routes that run closer to the marshes than the newer, incomplete, path. These paths all lead to the Anchorwood Bank area, where a new footpath inside the sea defence wall is accessible, although much of the site is still under development.

Figure 36. Aerial photo of sector 11494 (red boundary), the high tide roosts within it (white boundaries) and surrounds.

3.4.170 A single consistent high tide roost forms in this sector (Table 24), with this being focused at the eastern end of Penhill Marsh (Figure 36), though some species may use the entire marsh. Depending on the height of the tide, a roost may form on the eastern shoreline and can be difficult to observe.

3.4.171 Birds also use the creeks throughout the marsh as shelter during bad weather, which may also inhibit accurate counting. The roost may be more easily observed from the other side of the River Taw under certain conditions, although distance is an issue and it is not practical when undertaking WeBS counts of the wider sector.

3.4.172 In addition to the high tide roost at Penhill, an infrequent high tide roost on the shoreline and marsh to the east adjacent to the Taw bridge is also used, primarily by up to 30 Redshank. This roost has not been observed during WeBS counts. This site is subject to disturbance from dog walkers accessing the foreshore from paths through adjacent scrub and rough ground.

Table 24. Penhill high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		Notes
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	
Brent Goose	350		✓	M	50	50	May use whole marsh
Canada Goose	247		N/A	M	50	50	May use whole marsh
Shelduck	151			H	50	50	May use whole marsh
Black-headed Gull	280			H	0	100	May use whole marsh
Little Egret	26		✓	H	50	50	May use whole marsh
Curlew	209		✓	H	20	80	May use whole marsh
Lapwing	1000			L	20	80	May use whole marsh
Golden Plover	125			L	50	50	May use whole marsh
Dunlin	80	0		L	0	100	Shoreline
Redshank	6	0		L	0	100	Shoreline
Roost site habitat, substrate composition, other features (%)				**Further description and notes**			
Saltmarsh			90	OS Grid ref: SS 539 332 Estimated roost area: 800-1000 m^2			
Water			10				

Disturbance at the Penhill high tide roost

3.4.173 The Penhill roost is relatively undisturbed, although occasional dog walkers access the site from a gate on the Tarka Trail to the east. Some walkers will follow the shoreline around Penhill marsh if water levels allow, whilst others may walk over the marsh itself. Any incursion onto the marsh is likely to cause disruption to roosting birds.

3.4.174 Walkers accessing the marsh are invariably accompanied by dogs off the lead that may chase birds, and indeed, sometimes appear to be encouraged to do so. Disturbance from dog walkers has increased during the past four years (J. Broomhead, WeBS counter, *pers. comm*).

3.4.175 Flushed birds usually remain within the sector, as the size of Penhill marsh allows for relocation away from the disturbance event. However, birds flushed repeatedly (e.g. when chased by dogs) may evacuate the site completely. It is more likely for birds to vacate the site in conditions of high winds. It is not clear where birds are most likely to relocate too.

3.4.176 Penhill is a popular wildfowling area, which although an uncommon occurrence, can seriously disrupt feeding and roosting birds.

3.4.177 Angling and bait digging are popular in the early winter period to the east of Penhill Marsh, but there is usually no impact on birds roosting on the marsh at high tide.

3.4.178 Activities on the water such as gig or ski rowing tend to take place at a reasonable distance, and do not usually impact roosting birds. Powered vessels may prove more problematic but appear to be absent throughout winter.

Potential management and mitigation for the Penhill high tide roost

3.4.179 Signage to deter access to Penhill Marsh may help curtail the increasing pressure on the site from dog walkers. There is currently excellent stock fencing along the Tarka Trail as the marsh is still grazed. As a result, access is not straightforward, and most walkers will stick to the path. The current fencing should be retained and maintained regardless of future land use in the area.

Sector 11495 Fremington Pill and Quay

3.4.180 Fremington Pill is a tidal inlet of the River Taw with a defunct quay to the east of its mouth. At low tide, the Pill and surrounds are dominated by mudflats with a stone, mud and sand shoreline in the east running up the estuary shoreline to Penhill Point. This sector also includes much of Basset's Ridge, a large intertidal sandbank (Figure 37).

Figure 37. Aerial photo of sector 11495 (red boundary), the high tide roosts within it (white boundaries) and surrounds.

3.4.181 The sector holds two significant high tide roosts which, unusually for the TTE, are both highly species-specific.

Fremington Pill bank high tide roost

3.4.182 Fremington Pill is the most consistent and important high tide roost site for Redshank on the TTE (Table 25). The roost usually gathers along the engineered section of the western bank bordering Lovells Field, that is part of the Fremington LNR.

3.4.183 The roost is often mobile as the tide rises and floods preferred areas of mud bank with underlying stabilising matting, which eventually pushes birds up onto the grass verge where they might break up into smaller groups (Figure 38).

3.4.184 On neap tides, the section of the western bank of the Pill bordering houses just to the east of the engineered section may be preferred. There appears to be a preference for areas near anthropogenic structures such as steps.

3.4.185 Fremington Pill is used by a majority of the Redshank that roost there at high tide throughout the rest of the tidal cycle for feeding on exposed mud banks.

3.4.186 The high tide roost also frequently contains small numbers of Greenshank and the site occasionally hosts wintering Spotted Redshank *Tringa erythropus.*

3.4.187 It is of interest that the arrival of significant numbers (max count: 128) of Black-tailed Godwit *Limosa limosa* appeared to temporarily displace Redshank from Fremington Pill for part of the 2017-18 winter.

Figure 38. A small group of Redshank and a single Greenshank roosting on the bank at Fremington Pill following the breakdown of the main roost due to a high spring tide.

Table 25. Fremington Pill bank high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Redshank	150	100+	✓	H		100	
Greenshank	5	2	✓	M		100	
Roost site habitat, substrate composition, other features (%)				**Further description and notes**			
River bank, mud and grass			95	OS Grid ref: SS 517 327 Estimated roost area: 50 m^2			
Man-made structure			5				

Fremington Pill trees high tide roost

3.4.188 A stand of mature trees on the western bank opposite Fishley Quay, near the bridge at the B3233, is consistently utilised by Little Egret as a high tide roost. The roost may also be used at other tidal states and overnight and may also hold much rarer wintering Cattle Egret *Bubulcus ibis* when these are present on the TTE.

Table 26. Fremington Pill trees high tide roost species composition, utilisation and habitat characteristics.

Species	Estimated typical roost counts from previous 5 years WeBS core counts			Fidelity	Typical behaviour		
	Max count	Typical count	>5% of estuary population?	(% of visits present)	% Feed	% Rest	Notes
Little Egret	35	8	✓	M		100	
Roost site habitat, substrate composition, other features (%)				**Further description and notes**			
Trees			100	OS Grid ref: SS 521 325 Estimated roost area: 80 m^2			

Disturbance at the Fremington Pill high tide roosts

3.4.189 Disturbance is currently minimal at the Fremington Pill roosts despite the high numbers of visitors to the site. The Tarka Trail crosses Fremington Pill over an old railway bridge, but this is some distance from the roost sites.

3.4.190 The raised road down to Fremington Quay is consistently very busy with vehicle and foot traffic, but birds using the pill appear to be habituated to this activity and roosts form on the opposite bank.

3.4.191 It is possible that a wider range of waders, especially those known to be more prone to disturbance, could also use the site if it were not for the effect of this road.

3.4.192 It is possible that walkers access the western bank (Figure 38) of Fremington Pill, which would certainly disturb the roost sites. However, the use of this area appears to be extremely rare or even non-existent, as it has not been observed (J. Whittington, WeBS counter, *pers. comm*). Access is also possible from the

gardens of houses bordering the saltmarsh at the top of Fremington Pill, but again this does not seem to present an issue.

3.4.193 There are numerous boats in varied states of disrepair in Fremington Pill, though these are generally not attended during the winter. Water vessel traffic in any form has the potential to cause disturbance to the high tide roosts but is also not known to occur in winter.

3.4.194 Angling and bait digging are very popular around Fremington Quay in the early winter period, but neither activity impacts the high tide roosts and it is highly doubtful that these activities would be pursued on the Pill, especially at high tide.

Potential management and mitigation for the Fremington Pill high tide roosts

3.4.195 There is currently little need to focus any management or mitigation effort on the high tide roosts at Fremington Pill. The trees used by egrets could be subject to a tree preservation order (TPO) in order to protect them, although there is no current or obvious reason they may be felled.

3.4.196 Ongoing monitoring of the Redshank roost through WeBS counts and incidental observations from local birdwatchers are deemed sufficient to detect any future changes in site use that may threaten the high tide roosts.

Sector 11487 Barnstaple to Heanton

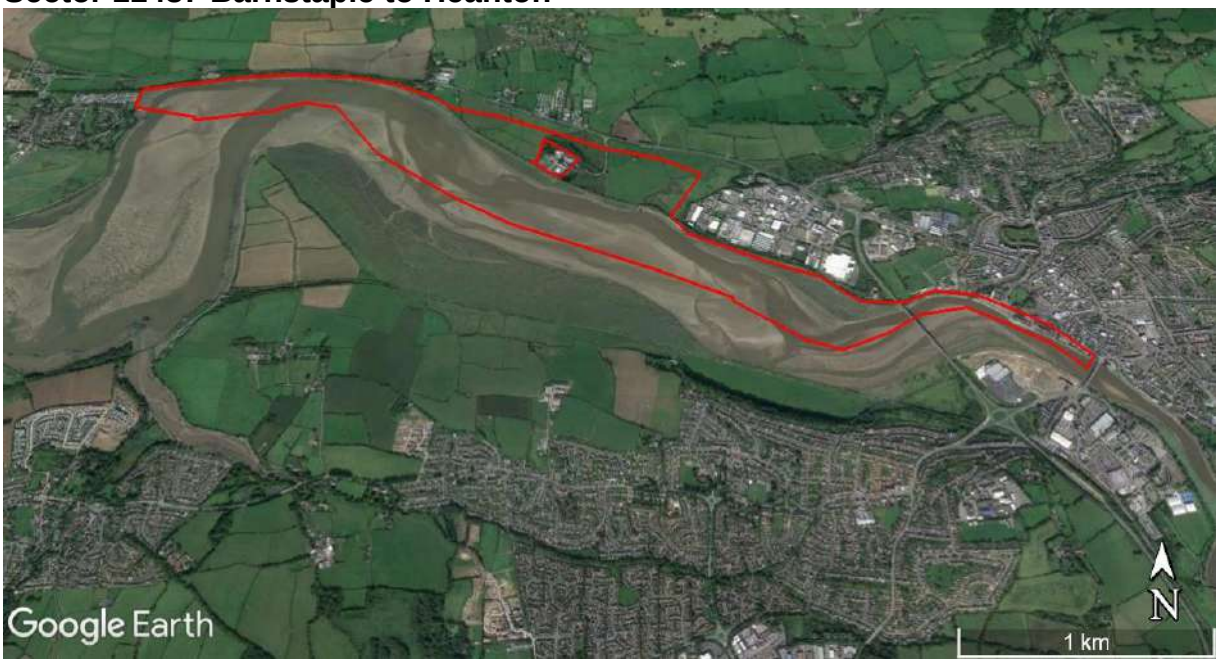

Figure 39. Aerial photo of sector 11487 (red boundary) and surrounds.

3.4.197 This sector is flanked along most of the northern edge by the Tarka Trail, with a muddy bay at the western end bordering Chivenor industrial estate. High tides flood much of the rocky shoreline and mudflats to the east, but after the Taw rounds Penhill Point on the opposite bank, there are sections of saltmarsh offshore of Ashford sewage treatment works and at Pottington, with the mouth of Bradiford

water meeting the estuary between them. Devon Birds manage a small reserve here.

3.4.198 There are no consistent high tide roosts on the estuary shoreline in this sector (T. Chaplin, WeBS counter, pers. comm). However, small wader roosts may form along the shoreline as the tide rises and can often persist if the area used does not become inundated. This behaviour can be seen on the shoreline of the marsh bordering the Pottington industrial estate and around the mouth of Bradiford Water. Redshank and Oystercatcher are most frequently observed in these roosts, and Lapwing may also be present in small numbers.

Sector 11492 Upstream of Barnstaple bridge

3.4.199 The River Taw runs south from Barnstaple where the channel narrows significantly, and the surrounding riparian habitat is mostly comprised of grazed floodplains.

3.4.200 There are no high tide roosts in this sector, despite two areas of significant bird interest;

- In the fields at New Bridge (SS 596 284), large aggregations of wintering Mute Swan *Cygnus olor* can be found.
- A stand of trees (SS 564 288) can host a significant Cormorant roost of up to 50 birds (M. Haworth Booth, WeBS counter, *pers. comm*).

Figure 40. Aerial photo of sector 11492 (red boundary) and surrounds.

4 Recreational disturbance impacts

4.1 An overview of recreational activities in winter

4.1.1 The TTE is utilised for a wide range of recreational activity. Formal groups or clubs were engaged (Table 27) using informal interviews conducted in person, by phone, or by email to provide an overview of activity in the October to March study period.

Table 27. Estuary user groups engaged by the study.

Activity	Clubs and organisations
Canoeing and kayaking	Bideford Canoe Club
Ski paddling	North Devon ski-paddling group
Wildfowling & shooting	Taw & Torridge Wildfowling Club
Sailing and powerboating	North Devon Yacht Club
Gig rowing	Barnstaple Pilot Gig Club Bideford Pilot Gig Club Appledore Pilot Gig Club
Angling and bait digging	North Devon Angling News
General activity	Taw Torridge Estuary Forum

4.1.2 Some activities are not well represented by formal groups and the information presented here represents a composite of local knowledge, direct observation and informal discussions with participants engaged in particular activities in the field.

4.1.3 Commercial and military activity is beyond the scope of this project, but anecdotal observations throughout the winter suggest that non-recreational activity, and disturbance to wintering birds arising from it, is rare.

Walking and dog walking

4.1.4 Walking is by far the most popular recreational activity on the estuary and takes place throughout. A high proportion of walkers are found to be accompanied by dogs, nearly all of which will be off the lead in open spaces.

4.1.5 There are few restrictions on dog walking in the study's focal period, with the very popular beaches at Instow, Saunton and Westward Ho! all having lifted any summer seasonal restrictions.

4.1.6 In addition to the major beach areas, intertidal habitat is also frequently accessed to its full extent by walkers with and without dogs at Grey Sands, the South Gut, Airy Point to Crow Point, the White House area, Yelland, Fremington and Appledore to Skern.

4.1.7 The Tarka Trail is well used by dog walkers, although other traffic and its constrained nature mean that it is not as popular as open areas, and dogs are more likely to be on the lead or less readily able to roam.

4.1.8 Sensitive areas bordering the estuary are also likely to be utilised by dog walkers. Braunton Burrows and Northam Burrows are both particularly well used and can

be especially busy in poor weather when the neighbouring beach areas are more exposed.

Jogging and cycling

4.1.9 The Tarka Trail is extremely popular with joggers and cyclists throughout the year, although use in the winter is heaviest at weekends and in better weather.

4.1.10 An overwhelming majority of participants will not stray from the Tarka Trail or SWCP, reducing any chance of interactions with wintering birds using intertidal habitat on the estuary.

4.1.11 Jogging is also quite popular on the beaches where wetted, hard sand is preferred. Joggers may also be accompanied by dogs, invariably off the lead in open spaces.

Gig rowing

4.1.12 There are three gig (traditional six-oared Cornish rowing boat) rowing clubs on the estuary, based in Barnstaple, Bideford and Appledore and all are active throughout the winter period. An overview of their activity on the estuary is provided in Table 28.

4.1.13 In addition to club rowing, there are occasional regatta events when boats from further afield may visit the estuary to race against each other. Such events may attract as many as 30 boats. These events are rare in the winter period but do occur.

Table 28. A summary of gig rowing activity by club on the TTE.

	Barnstaple	Appledore	Bideford
Members	90 – 100	100	30
Boats	4	4	2
Tidal use	1.5 hours +/- high tide	Usually around high tide	Usually around high tide
Rowing session	1 hour	1 hour	1.5 hours
Session frequency (Oct-Mar)	Highly variable due to tides and weather	10 sessions a month	1 or 2 boats on the water most weekends
Areas of estuary used	Between Barnstaple old bridge and Heanton Court. Lower tides restrict boats to area between Barnstaple bridges. Usually follow channel.	All accessible areas of the estuary may be used. Routes dictated by weather, time, tide and crew preference.	River Torridge, estuary mouth out to the Bar bouy, occasionally the River Taw. Routes are dictated by weather, time, tide and crew preference.
Launch/ recovery	Castle Quay (primary site) or Rolle Quay (only at higher tides)	Appledore slipway, next to Churchfields	Bank End slipway, Bideford. Also use Appledore (both slipways) at low tides.
Restrictions	No rowing in >30mph wind gust speed. Follows British rowing lightening rule.	Poor weather, sea state.	Poor weather, sea state.
Specific training	Coxwains are instructed in rules of the water.	Rowers and coxwains received induction training.	Coxwains trained. All expected to respect the estuary.

Figure 41. Gig rowers approach Oystercatchers on an exposed sand bank near Skern

Kayaking, canoeing, stand-up-paddle boarding (SUP) and surf ski paddling

4.1.14 Bideford Canoe club currently (2018) has 135 members and is active year-round, although the winter period is not as popular due to weather conditions and a lack of daylight. Many of the club members are primarily interested in sea-kayaking but use the estuary in poor weather or for fitness training.

4.1.15 Most active club members are thought to go out every other week on average, with good weather being preferred. On pre-planned club organised trips there are usually 10-15 participants with river paddles being slightly more popular.

4.1.16 The Weare Gifford to Bideford section of the Torridge is particularly popular and easily accessed from the Little America steps and lay-by. A popular route for sea-kayakers involves launching at Appledore on an ebbing or low tide to paddle out to Bideford Bar before returning on the flooding tide.

Figure 42. A party of kayakers pass the Black Ground at Instow.

4.1.17 Stand-up-paddle boarding has exploded in popularity over the past 5-10 years and may be practiced in the surf zones at Saunton and Westward Ho! or on the calm waters of the estuary. Sites such as Instow, Appledore, Velator and Fremington

Quay allow easy access to the estuary with car parking in close proximity to the water.

4.1.18 Most stand-up-paddle boarders will tend to hug the shore line, taking advantage of their minimal draft, which may bring them into conflict with feeding or roosting birds.

4.1.19 A group of surf ski (a fast, long, narrow, sit on top rowing craft) paddlers use the estuary up to three days a week. There are usually five or six participants, but there can be as many as 30+ every other weekend. Skis are launched and retrieved at the marsh adjacent to the North Devon Leisure Centre due to the unsuitability of the Lynton House slipway on the opposite shoreline. All tidal states are paddled and sessions last 1-2 hours. Pre-paddle briefings remind participants to paddle away from wildlife and fishermen. Poor weather can prevent paddling, especially strong winds.

Kite surfing, wind surfing and surfing

4.1.20 Kite surfing is a relatively new sport, which since the late 1990's has become widely practised and to some extent has replaced wind surfing on the estuary. This shift in popularity has also precipitated a movement of wind-powered recreational activity out of the inner estuary to the coastal surf zones at Westward Ho! (Sandymere area) and at Saunton Sands.

4.1.21 Although kite surfing does take place in the estuary, particularly to the south of Braunton Burrows (Figure 43), it is not as regular a sight as wind surfing once was in the area around the mouth of the Taw.

Figure 43. A wind surfer and a kite surfer near Crow Point.

4.1.22 Kite surfing requires cross-shore or cross-onshore winds of force 4 or above. High speeds can be achieved allowing participants to access wide areas of estuary, though most do not generally stray too far from their launching point.

4.1.23 Relatively recently introduced parking charges at the Instow Sandy Lane car park may have deterred some wind and kite surfers. This area is still used, particularly by wind surfers, but numbers are generally low.

4.1.24 Surfing is very popular at Westward Ho! and Saunton Sands, with the car parks at Saunton and Sandymere (Northam Burrows) structuring the use of the beach by surfers. Wave quality at Saunton is higher next to the Downend rocks, further aggregating surfers at this end of the beach.

4.1.25 Surfing also occurs during bigger swell events at Downend Point itself, Crow Point (groynes area), Grey Sands, and during exceptionally high tides and large swells, even the Black Ground area at Instow may be surfed. It should be noted that this is an extremely rare (once a decade) event. It may be speculated that rising sea levels due to climate change could possibly mean that Instow becomes a more frequently used surf spot.

4.1.26 Wave quality at all locations is heavily influenced by wind direction, tide and specific swell parameters. However, poor quality surf may still attract high numbers of surfers. The weekends and any holiday periods are particularly busy, but weekdays will also be busy during good conditions. Surfing attracts people from all over the country on day trips and longer holidays throughout the year as well as many local participants.

Angling and bait digging

4.1.27 Angling is a popular and commonly observed pursuit on the estuary, although there is a strong preference for areas in the estuary mouth and the River Taw. Through the October to March period three main quarry species are fished for: European Bass *Dicentrarchus labrax*, Atlantic Cod *Gadus morhua* as ‘codling’ (smaller specimens) and Flounder *Platichthys flesus*.

4.1.28 Bass are fished for until the end of October on a catch-and-release basis with the lower estuary area being favoured, particularly at Grey Sands and the Crow Point to Airy Point beach. Codling, albeit in low numbers, are also angled from these locations from October to February.

4.1.29 Flounder fishing is the predominant occupation of the estuary’s anglers and the season runs from September, with local tradition tying the start of the season to the arrival of the annual Barnstaple town fair. The season finishes in January as fish start to move out of the estuary to offshore spawning grounds. Many anglers will stop fishing for Flounder after Christmas.

4.1.30 Two angling clubs run annual one-day Flounder competitions, which represent the busiest angling days of the year on the estuary (Figure 44). In 2018, Bideford Angling Club and Barnstaple Triple Hook Club ran their Christmas Competition events which saw 58 anglers on the Torridge and 50 on the Taw. These numbers

are much higher than a normal daily count of anglers. Although it is difficult to gather a full estuary count, anecdotal same-day observations of the favoured areas suggest there may typically be 2-12 anglers present on the TTE at any one time during the Flounder season.

Figure 44. Anglers at Pottington during an estuary wide fishing match in December.

4.1.31 Bait digging focuses on Lugworm *Arenicola marina*, Common Ragworm *Perinereis cultrifera* and Harbour Ragworm *Hediste diversicolo*. Bait digging is most frequently undertaken on the River Taw around Pottington and Penhill, Fremington Quay area, at Instow between the Black Ground and Cool Stone, off Horsey Island and around the mouth of the River Caen. On the River Torridge the mudflats between Instow and East-the-Water are used. Bait digging may also occur at any suitable location away from the 'hot-spots'.

4.1.32 Anglers and bait diggers tend to access and exit the estuary in the same location and are usually quite sedentary. However, individuals may be present for a prolonged period of time, meaning that following an initial disturbance response, birds may continue to be displaced from an area.

Wildfowling

4.1.33 The Taw Torridge Wildfowling Club (TTWC) has approximately 60 members with no more than 23 thought to be active. Most active members are relatively local to the estuary, although a few are based further afield in Cornwall or Somerset. Returns from the 2017-18 season (1 September to 20 February) indicate that members made 117 visits to the estuary.

4.1.34 The shooting season starts in earnest with the arrival of wintering Wigeon in October, although there is some shooting for Canada Geese before this. Wigeon are the major quarry species (50 taken), with Canada Goose (33), Teal (23),

Mallard (13) and Pintail (12) also featuring in the clubs' returns. All birds are taken for the table and cannot be sold.

4.1.35 The TTWC leases approximately 650 hectares of marsh and tidal foreshore from the Crown Estate, mostly along the Taw. The areas used by members of the club are heavily influenced by other recreational users and wildfowl distribution. Increasing numbers of visitors to many parts of the estuary has structured the areas used by the club, with Penhill Marsh and surrounds on the south bank of the Taw and the mouth of the River Caen and marshes in the Chivenor area now being most popular. Some previously utilised areas such as the saltmarsh near Crow Point are now considered 'too busy' (used by the general public), and consequently, also no longer 'bird-rich' enough to shoot on.

4.1.36 Shooting is primarily a solitary pursuit and tends to take place at dawn or dusk, with most visits lasting 2-3 hours. However, shooting may occur throughout the day. Wildfowlers tend to prefer poor weather as ducks will fly lower and the wind muffles the sound of a shot, reducing disturbance, although better weather may also be utilised. The major influence of tide on shooting is the requirement for a shooter to have their feet 'in the mud', usually precluding shooting at higher tides. Beyond this, some individuals may prefer specific tidal states, but this is variable.

Sailing and powerboating

4.1.37 North Devon Yacht Club (NDYC) at Instow has approximately 700 members, although not all are local and more besides are not active sailors. It is estimated that 15% of the membership may participate in racing. A slipway at the club facilitates launching of dinghies and attendant safety boats.

4.1.38 Sailing in the study period is not as common as in the summer, but a winter dinghy race series is well-attended, and races can occur weekly from October to December, starting up again in March, with 12-20 boats typically participating. Race routes tend to be restricted to the estuary mouth area but may extend up the Torridge to the Appledore shipyard area and up the Taw to the White House area.

4.1.39 Larger sailing boats kept at moorings in the estuary channel are brought ashore by the middle of November, tide and weather permitting, though a small number stay at moorings through the winter.

4.1.40 Sailing in the estuary is tidally restricted with a four-hour window around the high tide being most popular. Neap tides may give more scope for sailing at lower tides, but spring low tides only allow access to a small area of water.

4.1.41 Powerboating on the estuary is rarely observed in winter and is more likely in October or November in better weather. Launching is primarily from Appledore slipway. Powerboats are often used to enable other activities such as fishing or water skiing, but all are less popular in the winter months or may not occur at all.

Other activities

4.1.42 Activity not fitting the categories above may be considered comparatively rare but can still result in significant disturbance effects and impacts.

4.1.43 Horse riding is a fairly popular activity at the beaches of Westward Ho!, Saunton Sands and Crow Point to Airy Point and can disturb feeding and roosting birds.

Figure 45. Motorbikes on intertidal sands off Penhill Point. © Rob Jutsam

4.1.44 The use of vehicles such as beach buggies, motorbikes (moto-cross) (Figure 45), hovercraft or air-boats (Figure 46), quad bikes and the like, are all an infrequent sight on the estuary; but may be significant in terms of cumulative disturbance of birds.

4.1.45 Describing patterns of use is difficult, but it is clear that significant disturbance usually arises from vehicle events. For example, on the March WeBS count a single airboat disturbed birds at several sectors on the River Taw and impacted the survey efficacy (Tim Davis, *pers comm*).

Figure 46. Hovercraft on the intertidal zone near the White House. © Rob Jutsam

4.2 Estuary user survey

4.2.1 To gather representative data on estuary usage an online survey titled "*Taw Torridge Estuary: Winter recreational use survey (October to March inclusive)*" was distributed to identified individuals, estuary stakeholder and user groups and subsequently promoted through social media channels to the wider community.

4.2.2 Eight multiple choice questions were asked, each with set responses (Appendix 2). Respondents could select multiple responses to the questions "What activities do you undertake at/on the estuary?" and "Where do you visit most frequently?". These responses were not weighted.

4.2.3 There may be some bias in the sample (*n*=315) to favour members of specific estuary user groups due to their dissemination of the survey. However, every effort was made to counter this through more general release of the survey by local councils and parish councils as well as promotion through local media.

4.2.4 In addition, estuary users were approached in the field and interviewed. These results (*n*=39) were also entered on the online survey platform.

Estuary user survey results

4.2.5 Many respondents take part in multiple recreational activities on the estuary and the full range of expected activity was found to occur. A basic analysis confirms that walking and dog walking are the most popular recreational activities on the TTE, with 68% and 45% of respondents stating that they undertake these activities respectively (Figure 47).

4.2.6 Somewhat surprisingly, bird and nature watching (43%) was more popular than cycling (41%) overall, although this might be considered a secondary activity by many walkers and dog walkers. Additionally, there is the prospect of respondent bias due to the topic of the survey. Cycling is not considered particularly relevant in a disturbance context as it is mostly limited to paths such as the Tarka Trail.

4.2.7 Kayaking, canoeing and ski paddling (21%) were found to be the most popular water-based activities, ahead of sailing (11%) and gig rowing (10%).

4.2.8 'Other' respondents usually specified a defined option, but those that did not most frequently stated simply enjoying the open space or peace and quiet. Photography, collection of litter and driftwood, and rock pooling were also mentioned.

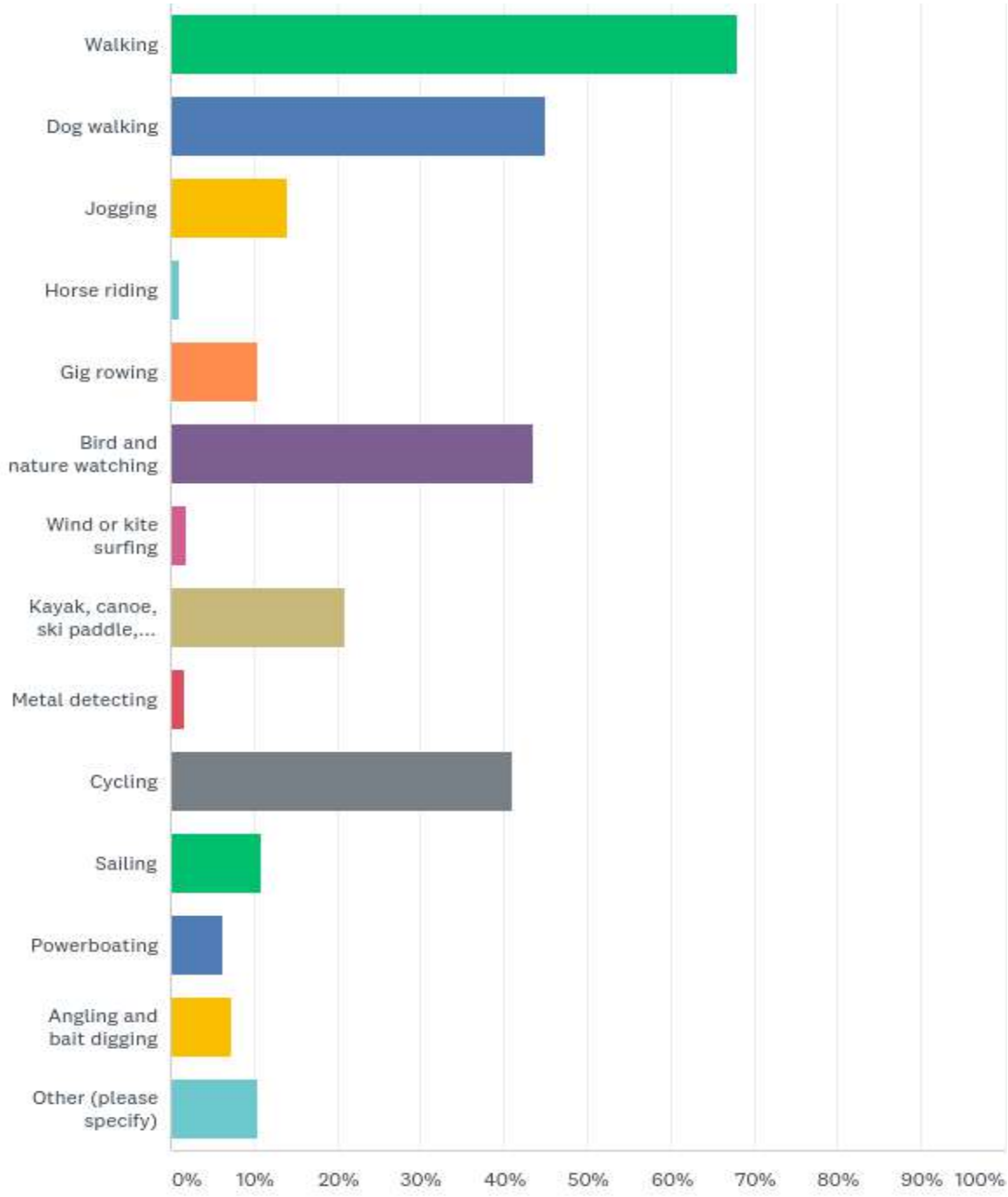

Figure 47. User survey question 1 "What activities do you undertake at/on the estuary?" according to 315 respondents.

4.2.9 Instow (54%), Westward Ho! (47%) and Appledore area (41%) were found to be the most frequently visited areas while the bird rich areas (see Section 3) of Chivenor (9%) and Heanton-Ashford (11%) were the least visited (Figure 48).

4.2.10 Visitors to Saunton (22%) appear to be under-represented as this site is thought to be as busy as Westward Ho!, although winter parking charges may be reducing numbers somewhat.

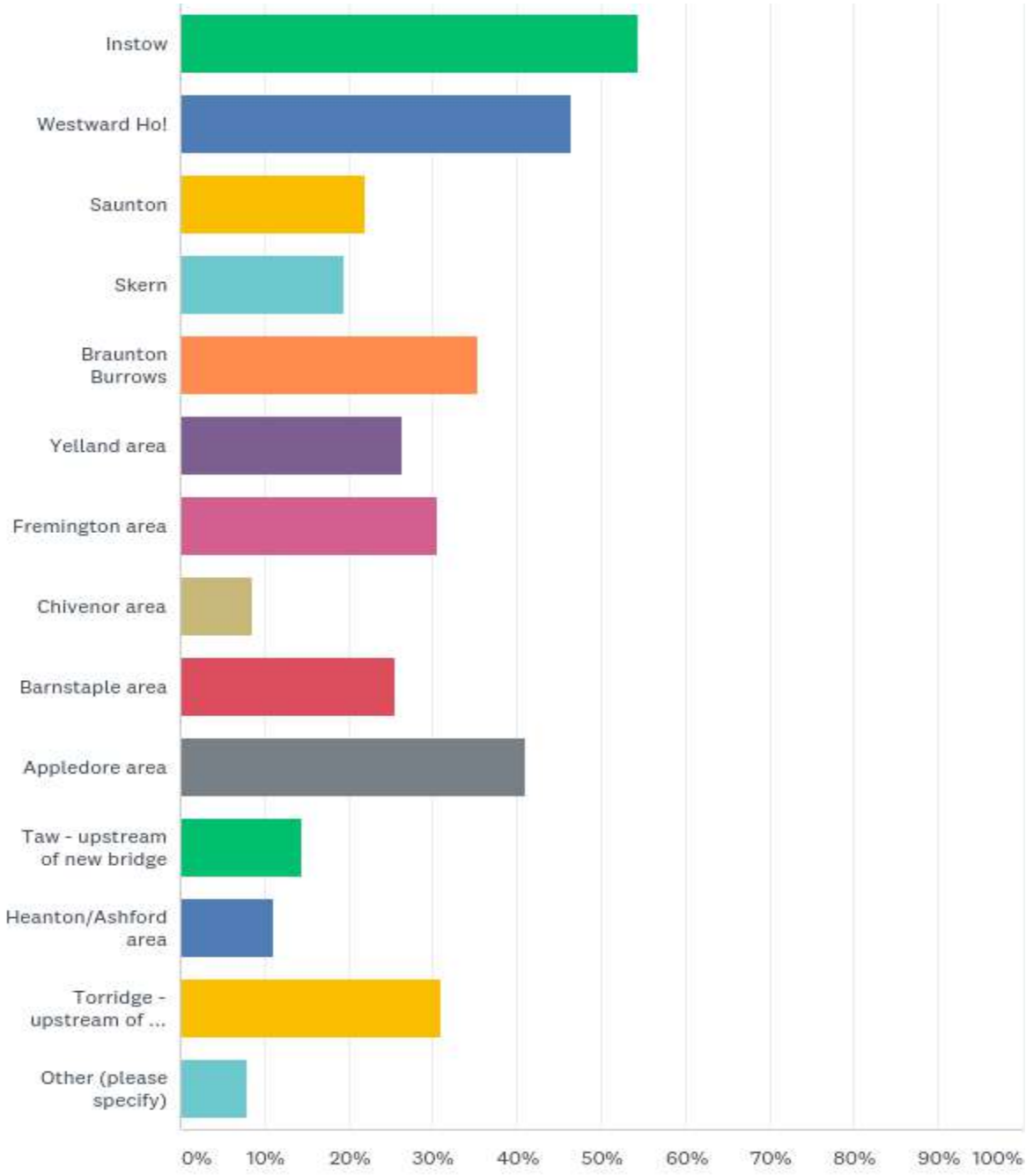

Figure 48. User survey question 2 "Where do you visit most frequently?" according to 314 respondents.

4.2.11 A majority (50%) of estuary users usually travel just 1-5 miles to access the estuary, with 20% travelling less than a mile and 19% travelling 5-10 miles (Figure 49).

4.2.12 It is possible that engagement with the online survey was highest amongst those living near the estuary, although interviews in the field and the distribution of major residential areas within 5 miles of the estuary would suggest that this is representative.

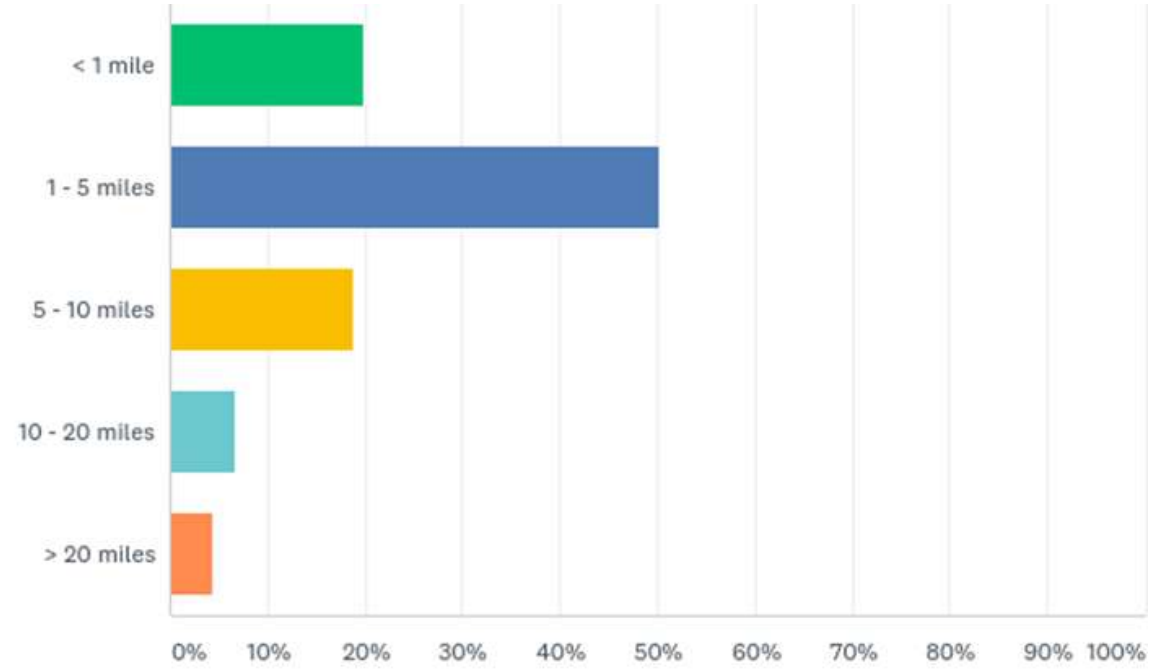

Figure 49. User survey question 3 "How far do you usually travel to access the estuary?" according to 313 respondents.

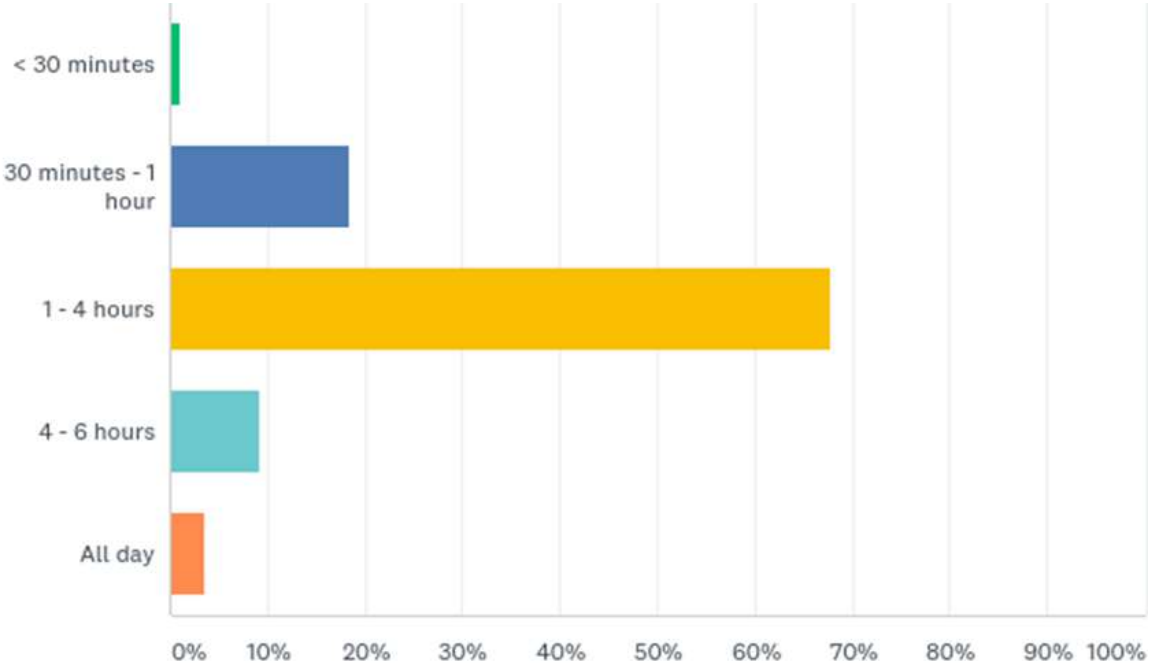

Figure 50. User survey question 4 "How long do you typically spend at the estuary?" according to 314 respondents.

4.2.13 Most estuary users (68%) stated that they spend 1-4 hours at the estuary on a typical visit, with a further 18% spending 30 minutes – 1 hour (Figure 50).

4.2.14 Most respondents visit the estuary frequently, with 31% visiting 2-3 days a week and a further 24% visiting daily or more than three times a week with an even split between those categories (Figure 51).

4.2.15 Interviews and discussions in the field identified numerous individuals that make multiple visits daily and may walk their dog up to four times a day on the estuary.

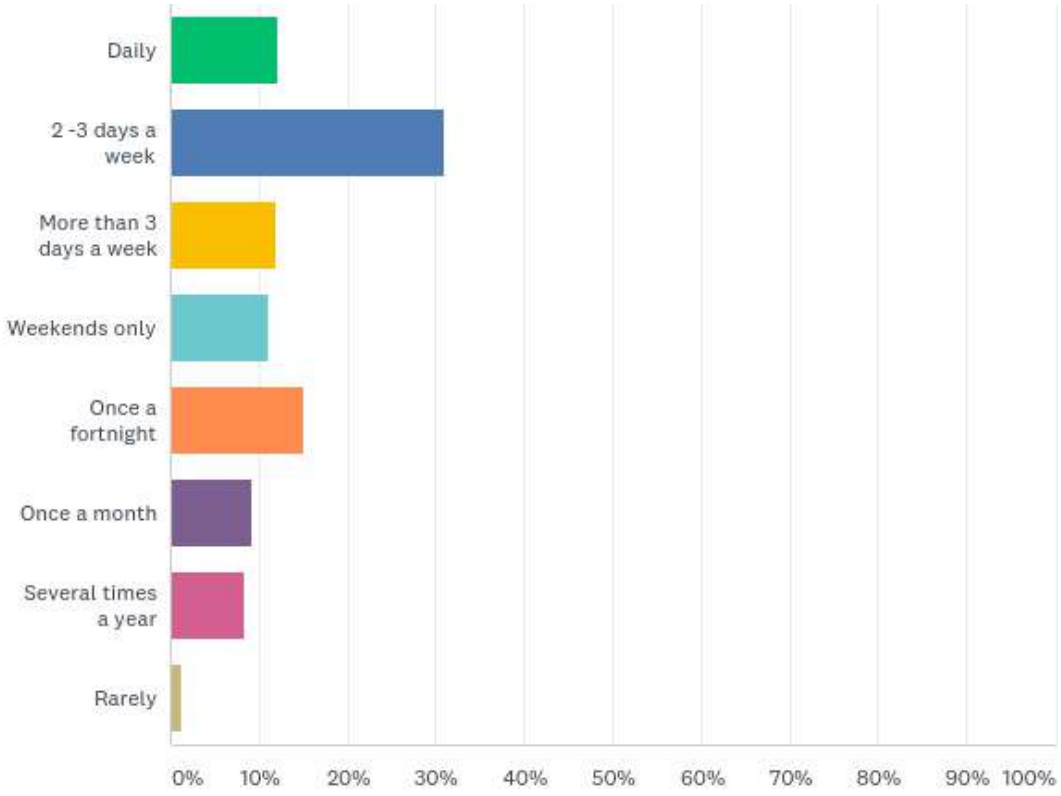

Figure 51. User survey question 5 "How frequently do you visit the estuary" according to 313 respondents.

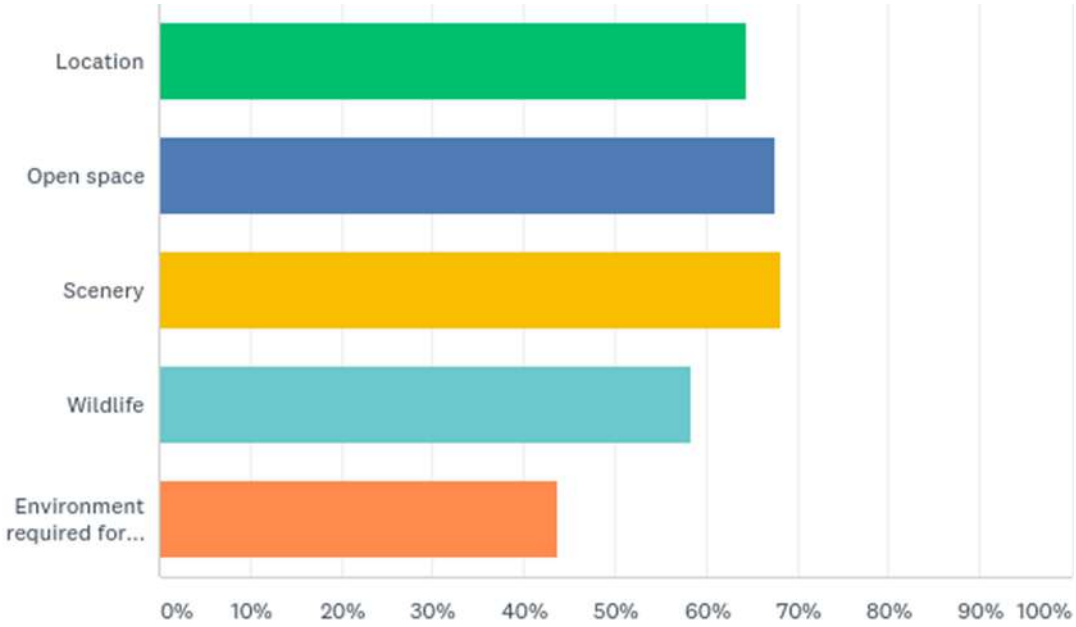

Figure 52. User survey question 6 "Why do you visit/use the estuary" according to 314 respondents.

4.2.16 "Location" (64%), "open space" (68%) and "scenery" (68%) were the most frequently cited reasons to visit or use the estuary (Figure 52), followed by "wildlife" (58%) and "environment required for specific activity" (44%).

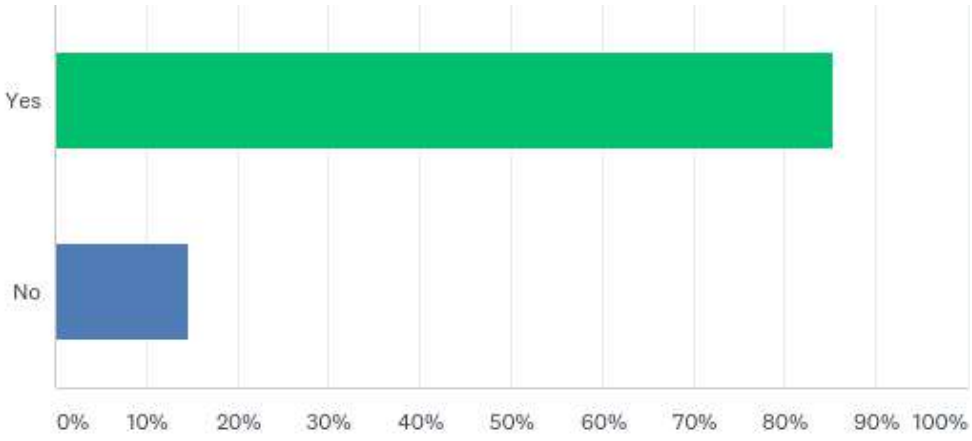

Figure 53. User survey question 7 "Are you aware the estuary is a site of special scientific interest (SSSI) and of particular importance to wintering birds?" according to 313 respondents.

4.2.17 Awareness of the estuary's SSSI status and importance to wintering birds was found to be high at 85% (Figure 53), although interviews in the field revealed an extremely basic understanding of the concept or simply a knowledge of the acronym as a symbol of the *status quo*, rather than what this may mean in terms of human-wildlife interactions or what this may mean from a legal perspective.

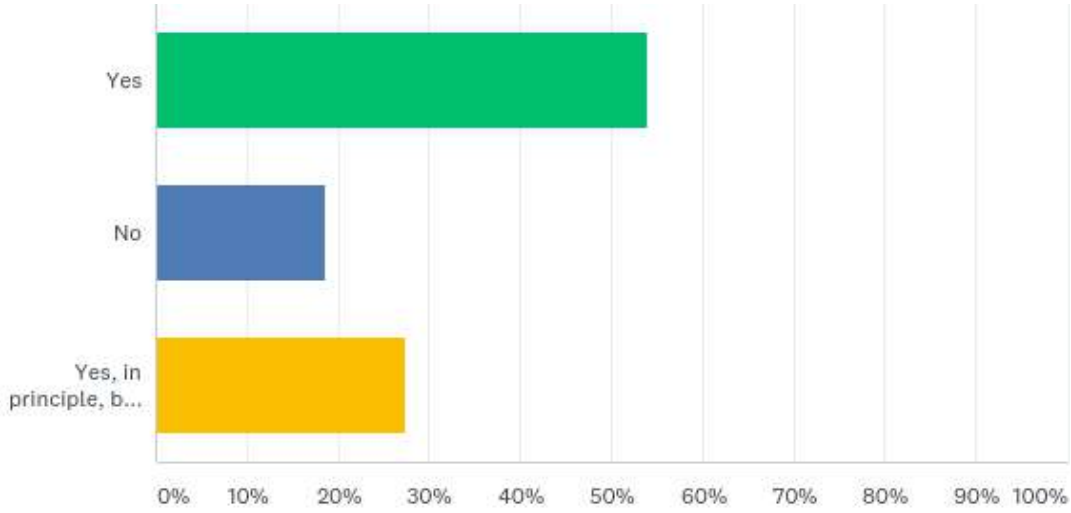

Figure 54. User survey question 8 "Do you believe there should be any management of human recreational activity on the estuary to benefit wildlife?" according to 311 respondents.

4.2.18 Finally, a surprisingly high number (54%) of respondents were found to be supportive of management of human recreational activity on the estuary to benefit wildlife (Figure 54). A further 27% of respondents supported management that would not restrict their use of the estuary, while 19% did not believe there should be any management of recreational activity.

4.3 Baseline levels of recreational activity on the TTE

4.3.1 In order to present a useful overview and define a baseline of the recreational activity deemed most likely to interact with wintering birds at a potentially significant level on the estuary, five event categories were identified according to the estuary user survey (see section 4.2 above) and recorded during field observations as follows:

- All pedestrian traffic - walkers, dog-walkers, joggers, metal detectorists and photographers
- Powered vessels - RIBs, jet-skis, fishing boats
- Non-powered vessels - gigs, kayaks, surf skis, stand-up-paddle boarders (SUPs), rowing boats and sailing boats
- Kitesurfing and windsurfing
- Angling and bait digging

4.3.2 These categories are considered to encapsulate the range of recreational activity commonly observed on the estuary. They are subsequently considered for each WeBS core count sector.

4.3.3 GIS mapping of activities in these categories was also undertaken to map the locations where these activities occur at different levels of frequency and intensity.

4.3.4 The frequency and intensity of events pertaining to each activity was scored for each month (October-March) using a simple scale (Table 29). Scores for each activity were informed by direct observations during a comprehensive survey programme (see Section 5), local knowledge and interviews with estuary users and experts.

Table 29. Scoring scale to define current baseline recreational activity levels.

Frequency of event occurrence per month		Average number of events per day	
Does not occur	-	Does not occur	-
0-10 days	A	0 < 10	1
0-10 days (mostly weekends)	B	10 < 25	2
10-20 days	C	25 < 75	3
20-30 days	D	75 < 150	4
Daily	E	150 +	5
Occurs but at an unknown frequency and intensity			✓

4.3.5 All events were scored considering usage of the intertidal or offshore area only. Levels of use of footpaths, roads, and the area above mean high water level (MHW) were not considered.

4.3.6 Scores were assigned to WeBS core count sectors to facilitate comparisons between wintering bird distribution and levels of activity on the estuary. However, specific patterns of recreational use were not consistent across these sectors, and were influenced by activity requirements, terrain, environmental conditions and access points.

Table 30. Levels of pedestrian traffic in each WeBS core count sector.

Sector code	Sector Name	Pedestrian traffic					
		Oct	Nov	Dec	Jan	Feb	Mar
11485	Upstream of Bideford	-	-	-	-	-	-
11484	Instow to Bideford	E 5	E 5	E 5	E 5	E 5	E 5
11486	Skern	E 5	E 5	E 5	E 5	E 5	E 5
11490	White House to Airy	E 4	E 4	E 4	E 4	E 4	E 4
11493	Saunton Sands	E 5	E 5	E 5	E 5	E 5	E 5
11496	Braunton Marshes	-	-	-	-	-	-
11497	River Caen and Horsey Island	C 2	C 2	C 2	C 2	C 2	C 2
11483	Isley to Instow	E 5	E 5	E 5	E 5	E 5	E 5
11488	Heanton to Caen	A 1	A 1	A 1	A 1	A 1	A 1
11482	Fremington to Isley	D 3	D 3	D 3	D 3	D 3	D 3
11495	Fremington Pill and Quay	E 4	E 4	E 4	E 4	E 4	E 4
11487	Barnstaple to Heanton	A 1	A 1	A 1	A 1	A 1	A 1
11494	Barnstaple to Penhill	A 1	A 1	A 1	A 1	A 1	A 1
11492	Upstream of Barnstaple	-	-	-	-	-	-

4.3.7 Pedestrian traffic in the intertidal zone is most frequent and intense at the beaches of Westward Ho!, Saunton Sands and Instow (Table 30). It should be noted that use of the Instow sector is almost completely limited to the main beach area. Daily, but less intensive traffic occurs at Skern (primarily along the low tide route of the SWCP) and at Fremington Pill and Quay on the foreshore out to Penhill Point.

4.3.8 Recreational pedestrian traffic on the intertidal zone is not thought to occur on Braunton Marshes, upstream of Bideford or upstream of Barnstaple.

4.3.9 Pedestrian traffic is very light at the Heanton to Caen, Barnstaple to Heanton and Barnstaple to Penhill sectors (Table 30). These sectors were identified as being of particular importance to wintering birds during the assessment of population distribution (Section 2).

Table 31. Levels of powered vessel traffic in each WeBS core count sector.

Sector code	Sector Name	Powered vessel traffic traffic					
		Oct	Nov	Dec	Jan	Feb	Mar
11485	Upstream of Bideford	A 1	A 1	A 1	A 1	A 1	A 1
11484	Instow to Bideford	C 1	A 1	A 1	A 1	A 1	A 1
11486	Skern	C 1	A 1	A 1	A 1	A 1	A 1
11490	White House to Airy	C 1	A 1	A 1	A 1	A 1	A 1
11493	Saunton Sands	-	-	-	-	-	-
11496	Braunton Marshes	-	-	-	-	-	-
11497	River Caen and Horsey Island	A 1	A 1	A 1	A 1	A 1	A 1
11483	Isley to Instow	A 1	A 1	A 1	A 1	A 1	A 1
11488	Heanton to Caen	A 1	A 1	A 1	A 1	A 1	A 1
11482	Fremington to Isley	A 1	A 1	A 1	A 1	A 1	A 1
11495	Fremington Pill and Quay	A 1	A 1	A 1	A 1	A 1	A 1
11487	Barnstaple to Heanton	A 1	A 1	A 1	A 1	A 1	A 1
11494	Barnstaple to Penhill	-	-	-	-	-	-
11492	Upstream of Barnstaple	-	-	-	-	-	-

4.3.10 There is very little powered vessel traffic on the estuary in the winter, which may be more prevalent in October in good weather (Table 31). Many smaller vessels, particularly those powered by outboard engines, are likely to be put into storage over the winter months.

Table 32. Levels of non-powered vessel traffic in each WeBS core count sector.

Sector code	Sector Name	Non-powered vessel traffic					
		Oct	Nov	Dec	Jan	Feb	Mar
11485	Upstream of Bideford	B 1	B 1	B 1	B 1	B 1	B 1
11484	Instow to Bideford	B 2	B 2	B 2	B 1	B 1	B 1
11486	Skern	B 1	B 1	B 1	B 1	B 1	B 1
11490	White House to Airy	B 1	B 1	B 1	B 1	B 1	B 1
11493	Saunton Sands	B 1	B 1	B 1	B 1	B 1	B 1
11497	River Caen and Horsey Island	B 1	B 1	B 1	B 1	B 1	B 1
11483	Isley to Instow	B 2	B 2	B 2	B 1	B 1	B 1
11488	Heanton to Caen	B 1	B 1	B 1	B 1	B 1	B 1
11482	Fremington to Isley	B 1	B 1	B 1	B 1	B 1	B 1
11495	Fremington Pill and Quay	B 1	B 1	B 1	B 1	B 1	B 1
11487	Barnstaple to Heanton	B 1	B 1	B 1	B 1	B 1	B 1
11494	Barnstaple to Penhill	B 1	B 1	B 1	B 1	B 1	B 1
11492	Upstream of Barnstaple	B 1	B 1	B 1	B 1	B 1	B 1

4.3.11 The use of the estuary by non-powered vessels is broadly uniform (Table 32), although some differences may emerge by specific activity or if using a finer scale of frequency and intensity.

- Gig rowing is concentrated in the lower reaches of the River Torridge, the Appledore and Skern estuary mouth area and at Barnstaple.
- Canoeing and kayaking can occur throughout but is probably most popular on the Torridge.

- Throughout winter SUPs are rarely observed away from the surf zone at Saunton but are occasionally seen elsewhere and could conceivably occur anywhere.
- Sailing races may feature, usually until December, causing higher use in the Instow to Bideford (11484) and Isley to Instow (11483) sectors, depending on race routes used.

Table 33. Levels of kitesurfing and windsurfing in each WeBS core count sector.

Sector code	Sector Name	Kitesurfing and windsurfing					
		Oct	Nov	Dec	Jan	Feb	Mar
11485	Upstream of Bideford	-	-	-	-	-	-
11484	Instow to Bideford	B 1	B 1	B 1	B 1	B 1	B 1
11486	Skern	C 2	C 2	C 2	C 2	C 2	C 2
11490	White House to Airy	B 2	B 2	B 2	B 2	B 2	B 2
11493	Saunton Sands	C 2	C 2	C 2	C 2	C 2	C 2
11496	Braunton Marshes	-	-	-	-	-	-
11497	River Caen and Horsey Island	B 1	B 1	B 1	B 1	B 1	B 1
11483	Isley to Instow	B 1	B 1	B 1	B 1	B 1	B 1
11488	Heanton to Caen	-	-	-	-	-	-
11482	Fremington to Isley	-	-	-	-	-	-
11495	Fremington Pill and Quay	-	-	-	-	-	-
11487	Barnstaple to Heanton	-	-	-	-	-	-
11494	Barnstaple to Penhill	-	-	-	-	-	-
11492	Upstream of Barnstaple	-	-	-	-	-	-

4.3.12 Kitesurfing and windsurfing are highly weather dependent and restricted to specific areas of the estuary (Table 33). The most popular locations are Westward Ho! in the Sandymere area and at Saunton Sands. On occasion kite surfers may even commute across the estuary mouth between these areas but most will stay within relatively close range of their entry point. In very good wind conditions, there may be >50 kite surfers (total) using the beaches at Westward Ho! and Saunton at any one time but this is not frequently seen. Such high numbers are not seen in the estuary.

Table 34. Levels of angling and bait digging in each WeBS core count sector.

Sector code	Sector Name	Angling and bait digging					
		Oct	Nov	Dec	Jan	Feb	Mar
11485	Upstream of Bideford	B 1	B 1	B 1	B 1	B 1	B 1
11484	Instow to Bideford	B 1	B 1	B 1	B 1	-	-
11486	Skern	C 1	C 1	C 1	C 1	C 1	C 1
11490	White House to Airy	B 1	B 1	B 1	B 1	B 1	B 1
11493	Saunton Sands	-	-	-	-	-	-
11496	Braunton Marshes	-	-	-	-	-	-
11497	River Caen and Horsey Island	E 1	E 1	E 1	E 1	E 1	E 1
11483	Isley to Instow	B 1	B 1	B 1	B 1	-	-
11488	Heanton to Caen	-	-	-	-	-	-
11482	Fremington to Isley	-	-	-	-	-	-
11495	Fremington Pill and Quay	C 2	C 2	C 2	A 1	-	-
11487	Barnstaple to Heanton	C 1	C 1	C 1	A 1	-	-
11494	Barnstaple to Penhill	C 1	C 1	C 1	A 1	-	-
11492	Upstream of Barnstaple	A 1	A 1	A 1	A 1	-	-

4.3.13 Angling is heavily influenced by the Flounder season in the TTE (see Section 4.1), leading to the decline and then absence of fishing in some sectors from December

to March. Angling in the estuary mouth occurs throughout the winter with Appledore RNLI slipway and Grey Sands Point being the most frequently utilised locations.

4.3.14 The daily use of the River Caen and Horsey Island relates to crab tiling and bait digging activities here, which in this instance is believed (but not confirmed) to be a commercial activity.

4.4 Spot counts and incidental records

4.4.1 To gather further information on recreational activity and intensity on the estuary, especially at some key areas around the estuary mouth (Table 35), spot counts of recreational activity were undertaken every 20 minutes (when possible) over one-hour periods by viewing discrete intertidal areas (Figure 55) using a telescope. Spot counts were made during all tidal states, weather conditions, and times of day.

4.4.2 Counts were made of individual walkers and dogs present. No attempt was made to group these observations due to the inherent difficulty and time required to do this. For example, a group of three walkers together with two dogs off the lead will have been recorded as five individuals in two categories, rather than being a single dog walking event. Likewise, individual boats, kayaks, etc are counted. No attempt is made to quantify the numbers of people involved with a vessel or vehicle. Therefore, in the context of spot counts and incidental records an 'individual' is counted and may be a person, animal or vessel/vehicle. The exception to this rule is a 'horse rider' which refers to both the horse and its rider.

4.4.3 Spot counts were made alongside surveying for disturbance effects on birds as a secondary activity so were occasionally suspended to prioritise the core disturbance recording objective. Poor visibility could also prevent counting.

Table 35. Survey effort and summary of observations at estuary mouth sites in October 2018 to March 2019.

Sector code	Count area	Observed from	Number of counts	Hours observed	Individuals counted
11490	Airy Pt and surrounds	Westward Ho!	47	13	104
11490	Crow Pt to groynes	Skern, Instow	107	25	582
11483	Instow to Yelland between jetties	White House	69	18	178
11486	Grey Sands beach and point	Instow	53	15	326
11484	Instow main beach	Instow, White House	101	23	4412
Total			**377**	**94**	**5602**

4.4.4 Spot counts at estuary mouth areas confirm that Instow beach attracts many more visitors than similar sites with less convenient access (Figure 56 & 57). The maximum count of 147 walkers at Instow main beach is not considered an unusual event.

Figure 55. Estuary mouth spot count area boundaries.

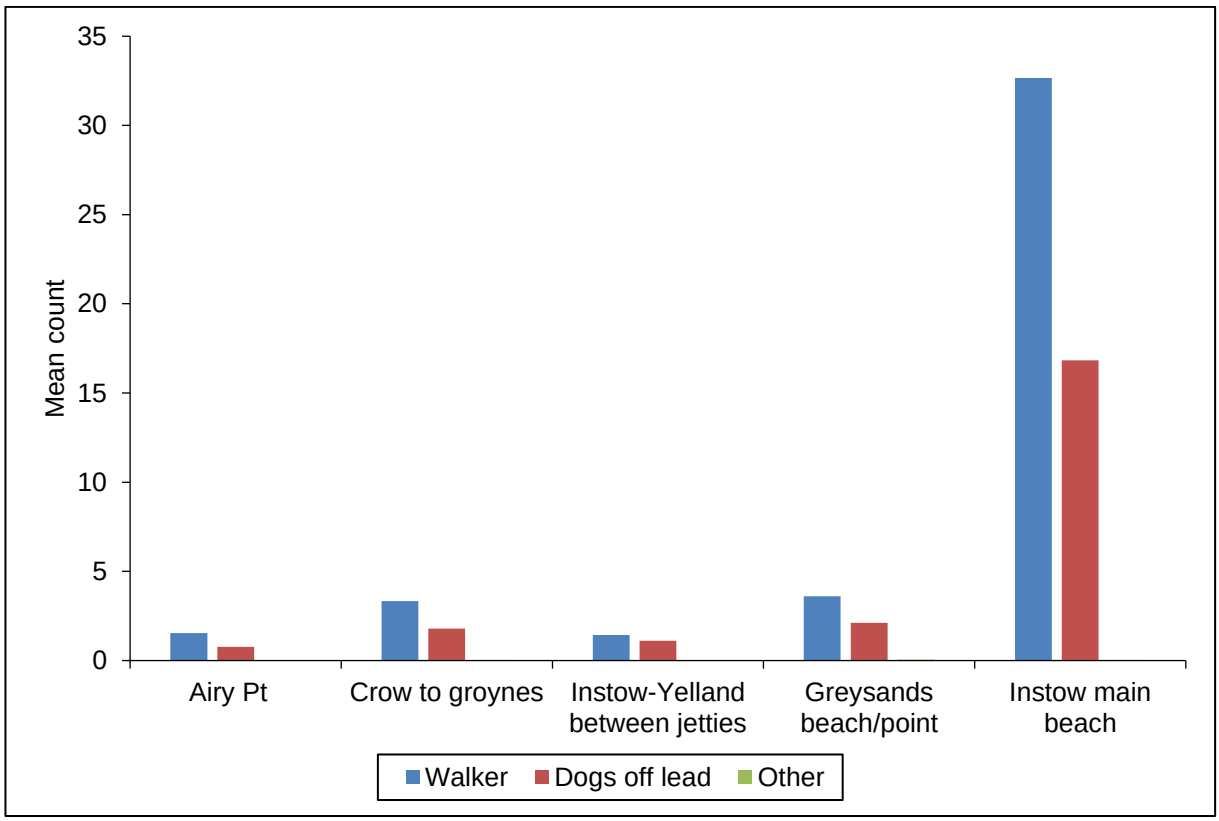

Figure 56. Mean counts of walkers, dogs off the lead and 'other' at spot count sites around the estuary mouth in October 2018 - March 2019.

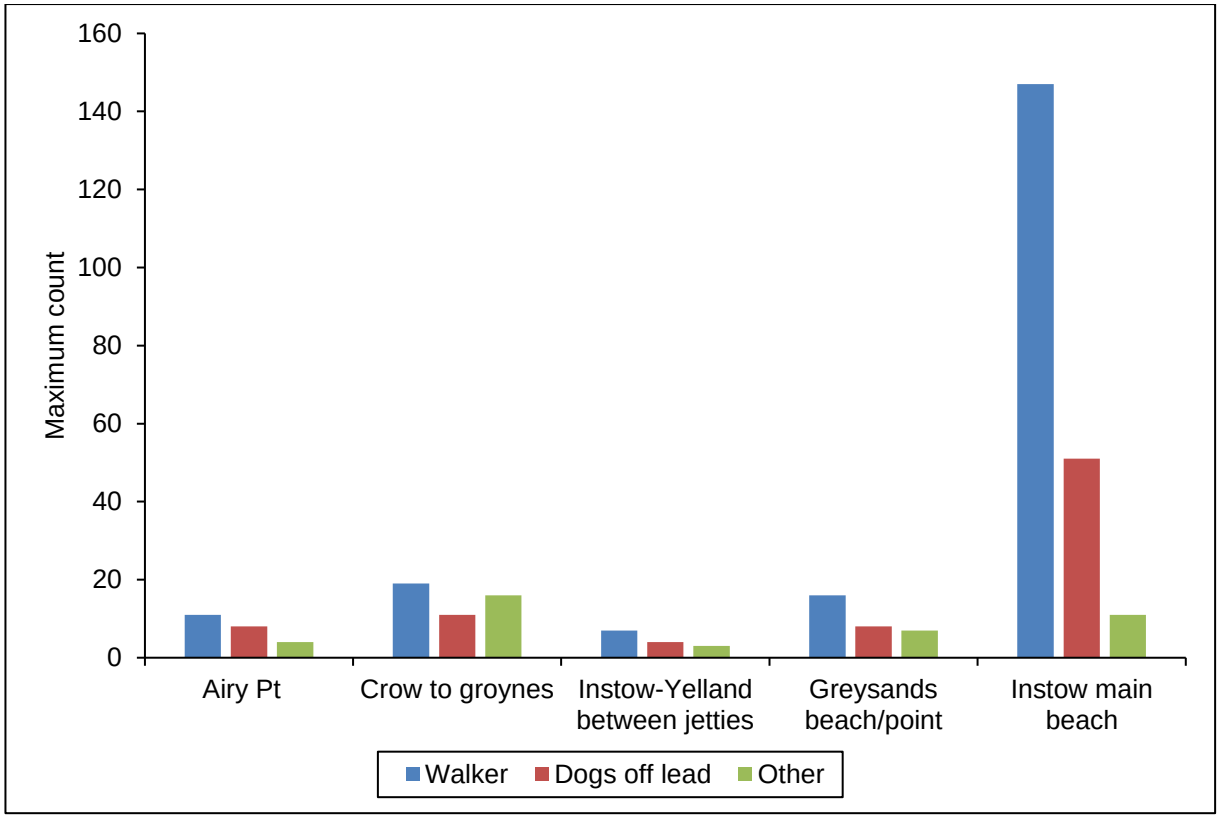

Figure 57. Maximum counts of walkers, dogs off the lead and 'other' at spot count sites around the estuary mouth in October 2018 - March 2019.

4.4.5 A maximum count of 16 'other' individuals at the Crow Point to groynes area refers to surfers there during an exceptional swell event. Otherwise, mean counts here were also dominated by walkers and dogs off the lead, as they were at all other sites (Figure 56).

4.4.6 In addition to the targeted spot counts systematically conducted at estuary mouth locations, spot counts and incidental recording of recreational activity was also undertaken on an ad-hoc basis across the entire estuary in order to help inform a baseline of estuary use (see Section 4.3 above). This approach enabled the recording of novel or rare events.

4.4.7 A combination of targeted site-specific spot counts and incidental counts is presented in Figure 58 to provide an overarching view on the use of the estuary for recreational activity. It should be borne in mind that this data was not collected systematically, and that survey effort was not evenly applied across the estuary. Nonetheless, the data presented is considered to be a relatively accurate representation of the recreational use of the estuary in the winter period.

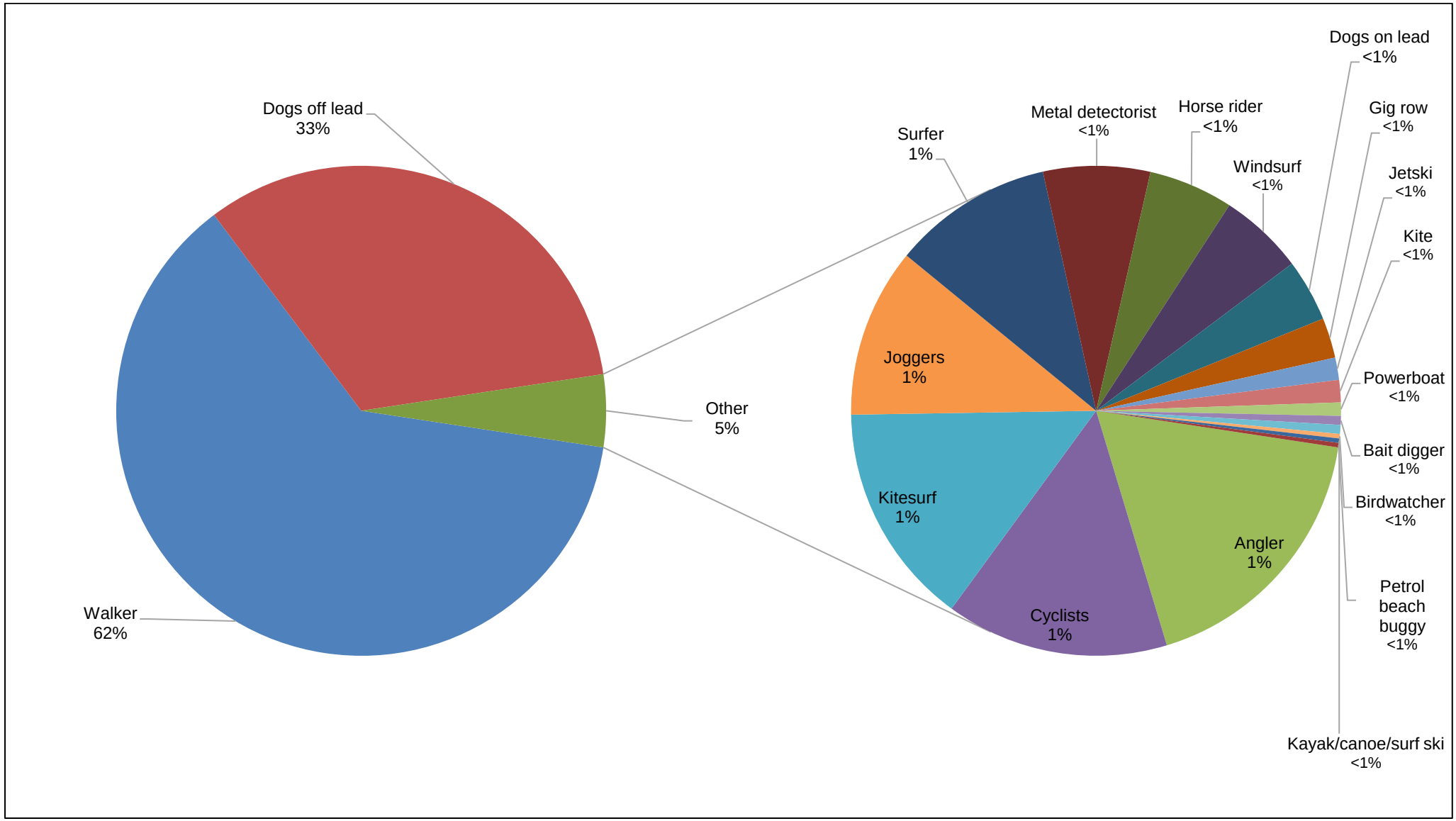

Figure 58. Proportions of individuals (*n*=7101) undertaking recreational activities observed during all spot and incidental counts (*n*=516) throughout the estuary in October 2018 – March 2019.

5 Disturbance surveys

5.1 Aims

5.1.1 In order to gather data on the interactions between recreational activity and wintering birds at the TTE fieldwork was planned in accordance with the following aims:

- In the locations of greatest value to waterbirds where disturbance is considered greatest, identify, record and describe disturbance events and the subsequent responses of birds with a measure of the response intensity.
- Determine thresholds for disturbance activity intensity and distance for birds and identify the characteristics of disturbance events that cause significant behavioural response in birds.

5.2 Methodology

5.2.1 In order to identify, record and describe disturbance events and the subsequent responses of birds with a measure of the response intensity a proven approach (Berridge, 2017) was utilised. This methodology was considered 'fit for purpose' in relation to disturbance monitoring of waders and waterbirds in high tide roosts by the RSPB and is broadly similar to the methods employed by Liley and others (2011) on the Exe estuary. In summary, the method entailed;

- Site visits of 1-hour duration were made throughout the study period to 6 study areas (Table 37, Figure 59). A series of consistent vantage point (VP) locations were employed to view recreational activity and any disturbance responses of WeBS species.
- To provide representative counts of WeBS species within a defined study area, instantaneous counts of all waterbirds on the ground or water were undertaken at 5-minute intervals using a 'snapshot' methodology.
- The study area was generally defined by the viewable 500 m radial distance of intertidal habitat from the VP, although in practice this was often constrained by physical barriers and the mean high-water mark. Good sight lines and a high-quality telescope enabled greater viewing distances at some sites.
- All counts were assigned to a tidal state. High and low tide counts were defined as starting within the +/- 2-hour period either side of the closest respective tide. All counts falling outside this period were defined as ebbing or flooding.
- If disturbance (e.g. flushing) events result in the detection of more birds than are represented in the snapshot counts, these are updated accordingly.
- It is assumed that birds counted at each snapshot are present in the study area until the following snapshot count, and birds arrived in the study area at the time of the first snapshot that they were counted in.
- Events causing disturbance are fully detailed. Type of event, counts of all individuals (e.g. two walkers and three dogs), start and end time, site

specific location(s) and habitat accessed (e.g. intertidal zone, shoreline) and any other notes are recorded.

- Due to the sheer volume of recreational activity at the study sites, recreational activity not leading to disturbance was not recorded in the same level of detail as events causing disturbance. Instead, only numbers of individuals were recorded (as for spot counts, section 4.4) and a generic number of 'events' was recorded as a tally. For example, walkers and dogs were tallied as individuals but also as groups, with the group representing an 'event'. This approach ensured full recording of disturbance responses, sometimes to multiple simultaneous events while maintaining the accurate collection of total 'individual' numbers.

5.2.2 The recording of disturbance responses focussed on visually (such as agitated movement, walking, swimming or flying away) or aurally (such as alarm calling) obvious behavioural responses brought about by human activity, using the definition put forward by Drewitt (1999) of "any situation in which human activities cause a bird to behave differently from the behaviour it would exhibit without the presence of that activity".

5.2.3 Disturbances caused by natural events such as the presence of a raptor (bird of prey) were also recorded to potentially enable a definition of a natural disturbance baseline, and for comparison of responses. Disturbance arising from other, non-recreational events, such as air traffic and military activity was also recorded separately. Both were rare.

5.2.4 In all cases, the level of disturbance response is recorded on a simple scale as detailed in Table 36. A response at level 5 refers to birds that leave the wider area and habitat rather than simply evacuating the observed focal area as located within the wider site. This represents a true abandonment of the site rather than an extended flight within it.

Table 36. Disturbance response scale.

Level of response	Description of response
0	No response
1	Alert but not moving (e.g. birds look up, appear agitated, vigilant)
2	Walk or swim away
3	Flushed to short flight (<50m)
4	Flushed to major flight (>50m)
5	Flushed, evacuates area completely

5.2.5 Disturbance responses were fully recorded to include, where possible, the following information;

- Species and count of individuals.
- Pre-disturbance behaviour and location/habitat.
- Proximity to the disturbing event at the initiation of each level of response.
- The elapsed time (until resuming pre-disturbance behaviour).
- Flight distance and new location/habitat (within site, or to another site).
- Escalating responses, such as becoming alert and then ultimately taking flight are chronologically detailed and individually described where possible.

- Birds were noted ‘as above’ if observed making multiple responses or subjected to numerous disturbance events. However, this was frequently impossible to determine.

5.2.6 All distances were estimated to the nearest 5m in the field. Known distances to visible landmarks were used as reference points at each VP. In addition, distance estimates were frequently sense checked by measuring on the relevant Ordnance Survey map at 1:25,000 scale.

5.2.7 Although not previously considered in the assessment of estuary populations as a result of its introduced non-native status, Canada Goose was considered in disturbance surveys in order to provide a fully representative picture of disturbance to all WeBS species on the TTE.

5.2.8 Six study areas were selected (Table 37, Figure 59). Sites were selected that were known to be important for wintering birds as well as being subject to full range of recreational activity, whilst also providing good geographical coverage of the estuary, including both rivers. All sites also have good access with nearby parking facilities and public rights of way.

Table 37. Overview of vantage point (VP) survey locations.

Site	WeBS sector	OS grid reference of vantage point	HT roost in area	Notes
Skern (north)	11486	SS 44893 30966	✓	VP used at high tide
Skern (south)	11486	SS 45103 30629	✓	
Westward Ho!	11486	SS 44077 31307		
Torridge	11484	SS 46687 28812		
Instow	11483	SS 47355 31377	✓	
Taw	11487	SS 54800 33351	✓	Inconsistent HT roosts
White House	11490	SS 46782 32691	✓	

Figure 59. Map of the areas (contained within red line boundaries) observed during disturbance surveys.

Skern survey sites

5.2.9 The Skern site was surveyed from two VPs. Initial surveys focused on the northern bay due to the major high tide roost there and historic disturbance issues resulting from incursion of people onto the intertidal zone in this area. However, surveys in October and November revealed very little recreational use and resulting disturbance at this locality.

5.2.10 From mid-December, observations were made from a VP allowing better viewing of the southern part of Skern Bay and the low tide route of the SWCP that had been identified as facilitating frequent disturbance of foraging birds on the foreshore. This VP was then used in preference, unless the area was inundated at high tide when the original northern VP was used instead.

5.2.11 Access to the Skern is facilitated by a road leading to a car parking area. Walkers also use the SWCP and access the area from Westward Ho!, Northam Burrows and Appledore. The area is a well-known birdwatching site and is important to a wide range of WeBS species for foraging and roosting.

Westward Ho! survey site

5.2.12 The Westward Ho! site was surveyed from a VP on the dune system to the north of Sandymere. This allowed observation of a large area of intertidal beach, rock and cobbles out to the beach and estuary mouth shorelines. Most walkers use the top of the beach, but many also venture out onto the intertidal rock and cobble areas, and yet more walk down to, and along the shoreline.

5.2.13 Access to the site is similar to Skern and walkers may use the beach and Northam Burrows to facilitate a circular route from the Sandymere or Grey Sands car parks.

5.2.14 In the latter part of the survey period very high tides and heavy rain caused flooding at Sandymere, restricting parking in the vicinity of the visitor centre and reducing levels of site access for recreational activity in this area.

5.2.15 There is no high tide roost at this site and the beach is often completely inundated at high tide, leaving only the pebble ridge exposed. However, the site is of importance at lower tides for foraging birds, especially Oystercatcher and Brent Goose. Furthermore, Golden Plover can frequently be found roosting amongst the exposed cobbles.

River Torridge survey site

5.2.16 The Torridge site was surveyed from the raised Tarka Trail, and both banks of the river were observed. Activity in the intertidal zone is generally restricted to the offshore area, leading to a quite different profile of disturbance at this site. A range of offshore traffic, both powered and non-powered, may be observed but is relatively infrequent.

5.2.17 The VP benefits from parking in an extended lay-by and bus stop on the B3233 which concentrates Tarka Trail access at this point. The western river bank immediately to the west of Appledore shipyard has steps allowing pedestrian

access to the intertidal zone from the SWCP, although such access was not observed. Instead, a small (presumed privately owned) slipway area just to the west was seen to facilitate pedestrian access to the intertidal zone.

5.2.18 The intertidal habitat is usually inundated at high tide, with few opportunities for roosting birds. However, herons and egrets roost on steep rock faces and trees on the western bank and small numbers of waders may roost on boats, buildings and other structures, especially at spring tides. On neap tides, the intertidal habitat may remain exposed, in which case ducks and waders may be seen feeding throughout the tidal cycle.

Instow survey site

5.2.19 Observations at Instow were conducted from the raised cricket pitch overlooking the Black Ground, Cool Stone, and the intertidal area in between. The main beach was not included in observations as a result of the extremely high levels of access for recreational activity and lack of use by birds.

5.2.20 The SWCP route runs on the seaward side of the cricket club sea wall and the Tarka Trail runs on the landward side. These paths are connected by two rights of way in the dunes immediately to the north of the cricket club that facilitate access to the beach area. Walkers also frequently approach from Yelland and the Tarka Trail and SWCP allow for circular walking routes.

5.2.21 Free parking is available on the road nearby or in the Sandhills car park. Charges at this car park that are enforced year-round have significantly reduced its popularity, and potentially reduced access and use of the northern part of Instow beach as a result.

5.2.22 The site holds an extremely important high tide roost, dominated by Oystercatcher, and is also used by a wider range of WeBS species for foraging and loafing at low tides.

River Taw survey site

5.2.23 The River Taw was surveyed from behind the sea defence wall on the Tarka Trail adjacent to Pottington industrial estate. As with the River Torridge site, this allowed observation of both sides of the river bank and adjacent marshes. The location of this VP also facilitated viewing up the River Taw toward Heanton and Penhill to assess bird numbers and recreational activity in those areas, although the distances involved were generally too great to make accurate counts.

5.2.24 The intertidal habitat viewable on the southern bank is more accessible to walkers than the north bank due to small footpaths across the marsh in that area, with gated access from the Tarka Trail in the west and a convoluted connection to the Anchorwood area in the east. The whole survey area is easily accessed from nearby residential areas.

5.2.25 Angling and bait digging are popular at this site, with the area immediately to the east of Penhill Marsh, the mouth of Bradiford water and between the creek

adjacent to the VP and Taw Bridge all being used. Barnstaple Gig rowing club and surf ski paddlers also use the estuary here.

5.2.26 Although not considered to hold a significant high tide roost a range of WeBS species do roost in this area in low numbers. On occasion, larger numbers may be present. At lower tides, large numbers of a range of WeBS species may be seen foraging in the area, although the estuary channel to the west from the Ashford sewage works to Penhill Point tends to hold a greater density of birds. The site is important for gulls throughout the tidal cycle.

White House survey site

5.2.27 The White House survey area focuses on the foreshore and saltmarsh in the bay protected by Crow Point. Although the high tide roost on Crow Point itself was not visible from the VP, on at least some occasions when it was flushed birds could be readily observed leaving the area. The saltmarsh high tide roost falls within the survey area.

5.2.28 Access to the area is from the Braunton Marsh toll road, and the VP is close to a busy car park. Walkers in the area can utilise a number of paths as well as intertidal beach areas. The VP also covers the estuary channel, where exposed sandbanks at low tide are usually cut off from the shoreline by deep channels.

5.2.29 A slipway near the White House provides access to the intertidal zone, although boat launching does not occur in winter. There is some maintenance of boats at moorings here. Wind surfers and kite surfers use the area in low numbers.

5.2.30 The survey area is used by a range of WeBS species throughout the tide, usually in low numbers. Nevertheless, feeding Wigeon and loafing Mallard can be particularly prominent.

Programme of work

5.2.31 A considerable amount of survey work was undertaken at the six described sites (see Table 37 above for details), with 146 hours of direct observation taking place over 49 days (Table 38). All times of day and tidal states were surveyed at each site.

Table 38. Overview of survey effort by month at all sites from October 2018 to March 2019.

Month	Days worked		Total days	Site visits (one hour)	Earliest start time	Latest finish time	Tidal states covered
	During Week	At weekend					
October	3	5	8	24	7:30	16:20	All
November	6	3	9	24	7:45	17:00	All
December	4	6	10	24	8:00	15:30	All
January	6	4	10	31	7:50	16:30	All
February	3	7	10	31	6:45	17:00	All
March	1	1	2	12	6:55	17:45	All

5.2.32 The relative spread of fieldwork over much of the study period increases confidence in capturing infrequent recreational activity (e.g. sailing races) or environmental events (e.g. exceptional tides) on the estuary.

5.2.33 Fieldwork was carried out in the October to March period and initially planned for equal monthly coverage at each site. However, after taking into account the constraints of the project timetable and the expected reduction of the numbers of individual WeBS species, particularly waders, in March, the decision was taken to focus observational effort on the January and February period (Table 38).

5.2.34 To account for an expected bias for most, if not all, recreational activities on the estuary to increase over the weekend relative to weekdays, 54% of site visits were undertaken at the weekend (Table 38).

5.2.35 Surveys were undertaken in all weather conditions, although the winter was generally dominated by uncharacteristically mild and dry conditions. It is thought that the findings presented here are inevitably influenced by weather conditions, as are the effects and impacts of disturbance to birds.

5.2.36 Temperatures ranged from -1°C to 20°C (mean 9°C) and wind speeds from all directions were experienced from light airs to gale force 8. Although rain, sleet, hail, and snow were all experienced during surveys, the usual weather conditions were overcast with sunny spells.

5.3 Patterns in count data

5.3.1 Counts of all WeBS species within the disturbance survey study areas (Figure 59) were undertaken at 5-minute snapshot intervals. Monthly mean and maximum counts for all observed species (*n*=40) give an insight into site use at the species level (Table 39).

Table 39. Mean and maximum monthly counts of all individual and total WeBS species observed, mean and maximum counts of number of WeBS species observed and the total number of WeBS species observed at each site.

	Instow		Skern		Taw		Torridge		Westward Ho!		White House	
Species	Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max
Great Northern Diver	0	1	0	0	0	0	0	0	0	0	0	0
Kingfisher	0	0	0	0	0	2	0	2	0	0	0	1
Snipe	0	0	0	5	0	5	0	0	0	0	0	0
Whimbrel	0	1	0	0	0	0	0	0	0	0	0	0
Black-tailed Godwit	0	1	0	1	1	8	0	0	0	0	0	2
Bar-tailed Godwit	0	1	1	5	0	4	0	9	0	0	0	2
Curlew	8	69	25	68	29	72	9	49	1	9	6	34
Redshank	2	17	18	92	23	169	5	17	0	0	2	7
Dunlin	1	51	51	519	8	381	0	0	0	6	3	64
Greenshank	0	0	0	3	0	0	1	19	0	0	0	1

	Instow		Skern		Taw		Torridge		Westward Ho!		White House	
Species	**Mean**	**Max**	**Mean**	**Max**	**Mean**	**Max**	**Mean**	**Max**	**Mean**	**Max**	**Mean**	**Max**
Common Sandpiper	0	1	0	0	0	1	0	2	0	0	0	0
Sanderling	1	11	0	0	1	16	0	0	9	132	0	2
Turnstone	2	14	0	3	0	1	0	0	0	1	0	0
Knot	0	0	0	5	0	2	0	0	0	0	0	1
Golden Plover	0	0	26	442	1	75	0	0	30	485	0	0
Lapwing	0	4	19	99	21	176	0	0	0	0	0	4
Grey Plover	1	3	3	18	0	2	0	0	0	0	0	7
Spoonbill	0	0	0	0	0	0	0	1	0	0	0	0
Avocet	0	0	0	1	0	0	0	0	0	0	0	0
Ringed Plover	3	22	0	8	0	0	0	0	0	0	4	44
Oystercatcher	192	837	60	436	23	69	6	17	23	356	5	138
Teal	0	0	2	22	0	1	4	22	0	11	1	12
Black-necked Grebe	0	0	0	0	0	0	0	0	0	0	0	1
Great-crested Grebe	0	1	0	0	0	1	0	0	0	0	0	0
Little Egret	0	2	1	4	2	16	1	3	0	1	1	3
Grey Heron	0	1	0	2	0	4	2	8	0	1	0	1
Scaup	0	0	0	0	0	0	0	1	0	0	0	0
Little Grebe	0	1	0	0	0	2	0	0	0	0	0	0
Goosander	0	0	0	0	2	14	0	0	0	0	0	1
Pintail	0	0	1	16	0	0	0	0	0	1	0	0
Eider	0	0	0	2	0	0	0	0	0	0	0	0
Mallard	0	0	0	2	5	45	3	61	0	0	19	65
Wigeon	12	56	30	198	0	0	10	67	0	15	16	152
Shelduck	0	0	15	61	7	41	6	22	0	2	2	18
Cormorant	0	4	0	5	7	34	0	3	0	5	1	14
Pink-footed Goose	0	0	0	0	0	2	0	0	0	0	0	0
Shag	0	1	0	0	0	0	0	0	0	1	0	0
Brent Goose	0	6	21	198	0	8	0	0	9	144	1	28
Mute Swan	0	0	0	0	0	0	0	3	0	0	0	0
Canada Goose	0	1	0	2	27	242	0	0	0	0	0	3
Total WeBS count	**223**	**862**	**274**	**1202**	**158**	**669**	**46**	**103**	**73**	**523**	**60**	**218**
WeBS species	**5**	**9**	**9**	**15**	**8**	**13**	**6**	**12**	**3**	**8**	**6**	**11**
Total species	**23**		**26**		**27**		**17**		**15**		**24**	

5.3.2 In terms of the key wader species on the TTE, Lapwing and Golden Plover were recorded at the River Taw and Skern survey sites, although Golden Plover were more frequently present at Westward Ho! at roost amongst intertidal cobbles. Moreover, none of the surveyed sites were found to be particularly well used by Lapwing with mean counts of just 21 at the River Taw and 19 at Skern sites (Table 39).

5.3.3 Curlew was recorded at all survey sites (Table 39) with the maximum count (72) being obtained on the Taw, where the mean count (29) was similar to that at Skern (25). The use of these two sites is distinctly different however, with the Taw being used for foraging at lower tides and Skern utilised for roosting at higher tides. Westward Ho! was the site used least by Curlew, possibly due to the species' sensitivity to disturbance.

5.3.4 Oystercatcher were also recorded at all sites (Table 39), but were most prominent at Instow, in keeping with the large and consistent high tide roost there. A maximum count of 837 Oystercatchers at Instow represents the single highest species count recorded. Westward Ho! and Skern were also important sites for Oystercatcher with maximum counts of 356 (foraging) and 436 (roosting) respectively. However, it is of note that the mean count for Oystercatcher at Westward Ho! of 23 is the same as at the River Taw, where a maximum count of 69 was noted, indicating reduced site fidelity at Westward Ho!. This may be due, at least in part, to disturbance levels.

5.3.5 Overall species richness was consistently highest at Skern (Table 39), indicative of the varied intertidal habitat present, although the greatest number of species overall was recorded on the River Taw. Westward Ho! was found to be the most species-poor site, probably due to the restricted range of habitats in the survey area, although higher levels of disturbance may also have been a contributing factor.

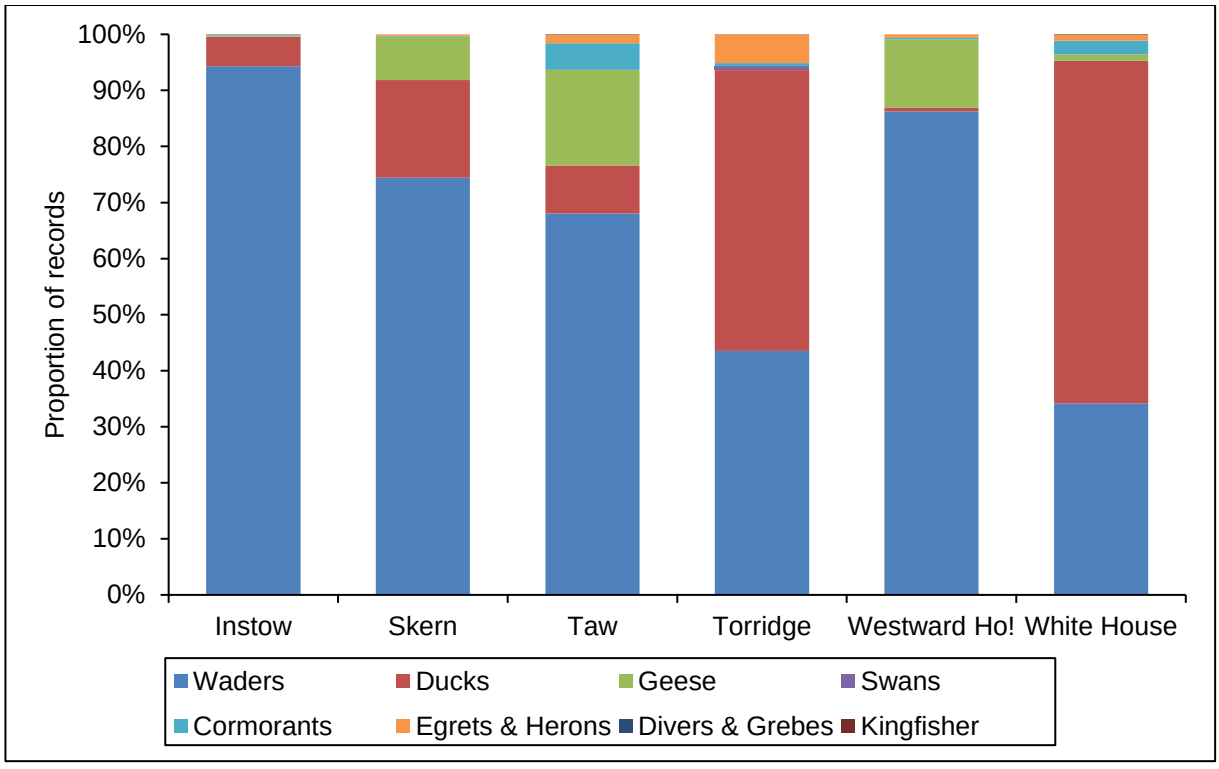

Figure 60. Proportional use of all study areas by species group in the October 2018 – March 2019 period (from mean counts).

5.3.6 The proportional use of each site by species group according to the mean counts encountered varied markedly (Figure 60).

5.3.7 Waders were the most numerous species group at most sites, most notably at Instow and Westward Ho! where Oystercatchers tended to dominate the assemblage. Waders were also the most numerous component of the WeBS species assemblage at Skern and on the River Taw (Figure 60).

5.3.8 Ducks were more prominent on the Torridge, where the prevalence of soft mud presents foraging opportunities for Teal and Shelduck and is generally less suitable for waders. Ducks were also a significant feature of the assemblage at the White House, where good numbers of Mallard and Wigeon were also observed on occasion (Table 39). Mallard were usually found roosting on the steep sided shoreline at low tide while Wigeon tended to forage on the saltmarsh edge.

5.3.9 The influence of the river channel is apparent on the Taw, Torridge and White House sites where the river is used by Cormorants. Similarly, piscivorous (fish-eating) herons and egrets were also more prominent at these sites.

5.3.10 The effect of tide on the observed ornithological assemblage at most survey sites was pronounced, as shown by the varying mean total counts of WeBS species at each site (Figure 61).

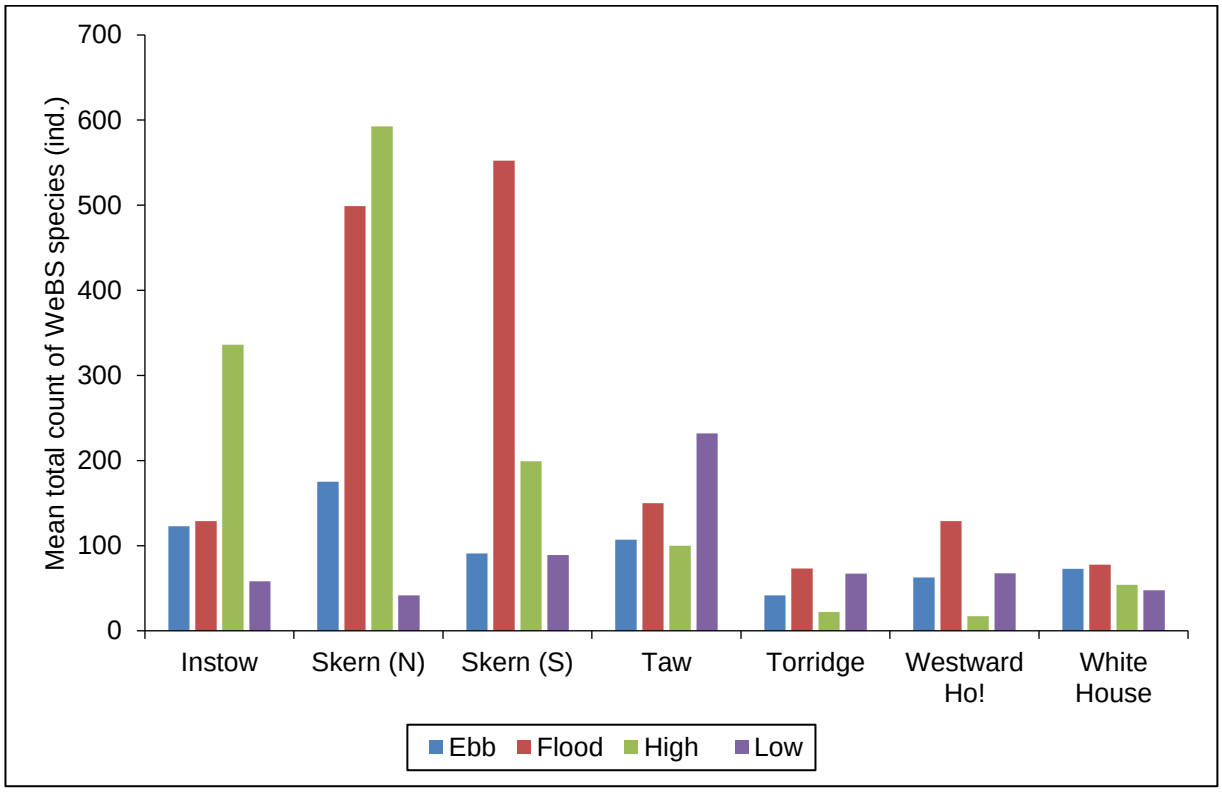

Figure 61. Mean total counts of all WeBS species at each survey site during each tidal phase in October 2018 to March 2019.

5.3.11 As to be expected from the presence of significant high tide roosts, the mean total counts of WeBS species at high tide were highest in the northern part of Skern Bay and at Instow (Figure 61).

5.3.12 Despite the presence of a high tide roost at the White House, counts here were higher on the ebb and flood tide. This may be due to a lack of undisturbed roosting

habitat at this site at high tide as walkers readily access and traverse the shoreline.

5.3.13 The lowest mean high tide counts were noted at the River Torridge and Westward Ho! as a result of suitable habitat at these sites being inundated, which forced most birds to use high tide roost sites elsewhere.

5.3.14 The flooding tide appeared to be particularly important in the southern part of the Skern site and at Westward Ho! (Figure 61), with high numbers of birds recorded at this time. Birds at these sites were presumably gathering to loaf and feed before flying to the major roost located in the north of Skern Bay.

5.3.15 The only site with a peak mean count at low tide was the River Taw, reinforcing the area's importance for feeding birds at low tide. The pattern of the lowest counts usually being reported at high tide also confirmed the lack of consistent high tide roosting behaviour in the area (Figure 61).

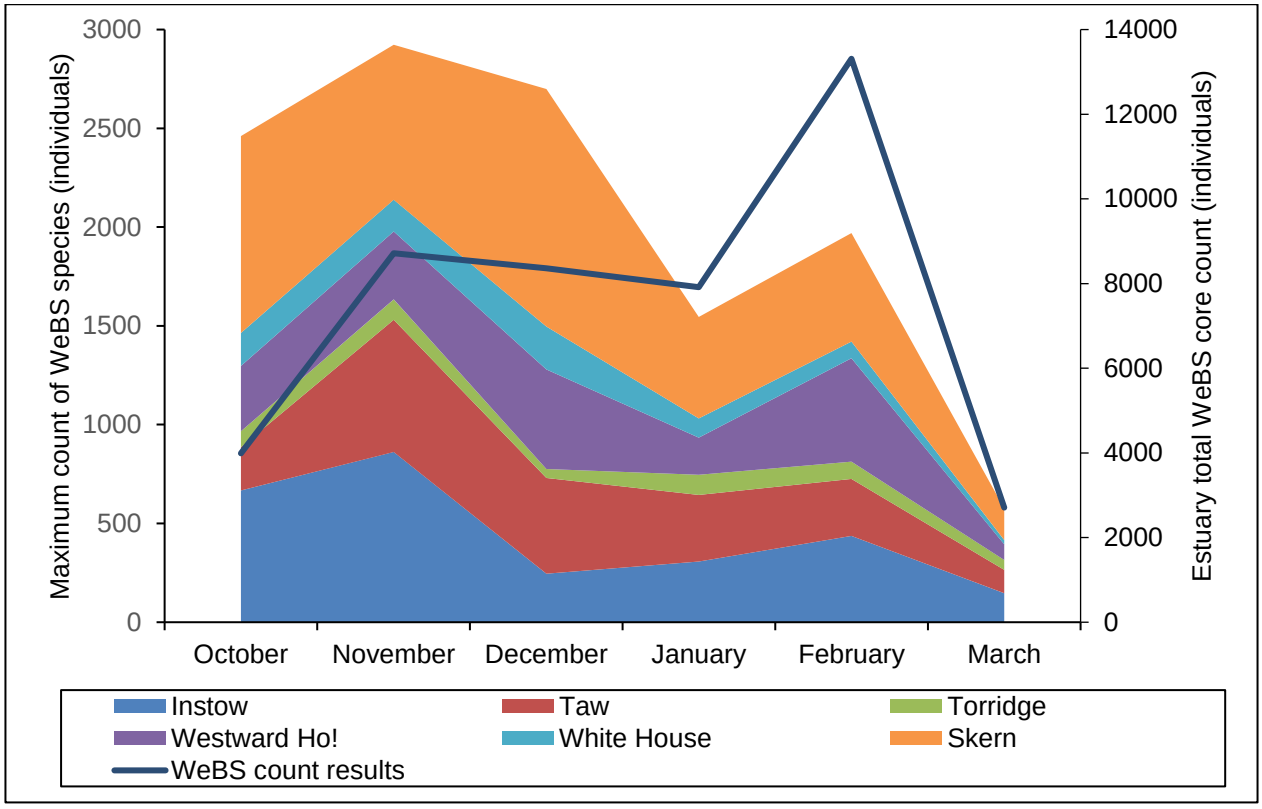

Figure 62. Stacked maximum monthly counts of all WeBS species at each of the six disturbance survey sites and the total estuary count from WeBS data.

5.3.16 The maximum counts from each survey site in each month show a general increase to peak populations in November before generally declining as the winter progresses, with lowest numbers by mid-March. (Figure 62).

5.3.17 The peak winter WeBS core count was achieved in February and was not reflected by bird counts during survey work. This is due to the peak count being driven by Lapwing and Golden Plover numbers away from the survey sites.

5.4 Interactions between recreational activity and WeBS species

General patterns

5.4.1 A total of 1535 recreational activity events were recorded, of which 1297 events (84.5%) did not lead to any observed disturbance to WeBS species (Table 40).

5.4.2 The proportion of events causing disturbance varied by site but follows a general pattern of increasing proportion causing disturbance with decreasing total events (Table 40). Habituation of birds to recreational activity and/or the avoidance of specific areas frequently used for recreational activity by birds may partially explain this pattern.

Table 40. Summary table of all recreational activity events recorded at each study site in October 2018 to March 2019.

Site	Events with no disturbance		Events causing disturbance		Total event count
	Count	%	Count	%	
Instow	262	83.7	51	16.3	313
Skern	100	71.4	40	28.6	140
Taw	7	26.9	19	73.1	26
Torridge	22	64.7	12	35.3	34
Westward Ho!	576	89.4	68	10.6	644
White House	330	87.3	48	12.7	378
Total	**1297**	**84.5**	**238**	**15.5**	**1535**

5.4.3 When considering the overall number of events recorded across all survey sites Westward Ho! is identified as the 'busiest' site overall with a total of 644 recorded events, although only 10.6% of these events caused disturbance to birds. However, it is suggested that birds are completely excluded from much of the site due to the high levels of pedestrian traffic.

5.4.4 At Instow, the White House and Skern the proportions of events leading to disturbance reflects the likelihood of dog walkers accessing areas utilised by birds. At the Skern, where the SWCP is routed through the intertidal zone it is inevitable that a greater proportion of events will cause disturbance (up to the point where complete exclusion occurs). By contrast, at the White House, walkers may have to diverge from the usual routes to come into conflict with feeding birds on the intertidal zone.

5.4.5 At the River Taw and Torridge comparatively few recreational activity events were observed (Table 40). Levels of recreational activity were slightly higher on the Torridge, perhaps because of its closer proximity to the estuary mouth than the Taw site. At the River Taw study site 73.1% of events caused disturbance, however, at the River Torridge site only 35.3% of recreational activity events caused disturbance (Figure 64). This difference could be due to the lower density of birds at the Torridge site (see Section 5.3) but may also be explained by the different levels of recreational activity by type at each site (see Figure 65 & 68 below).

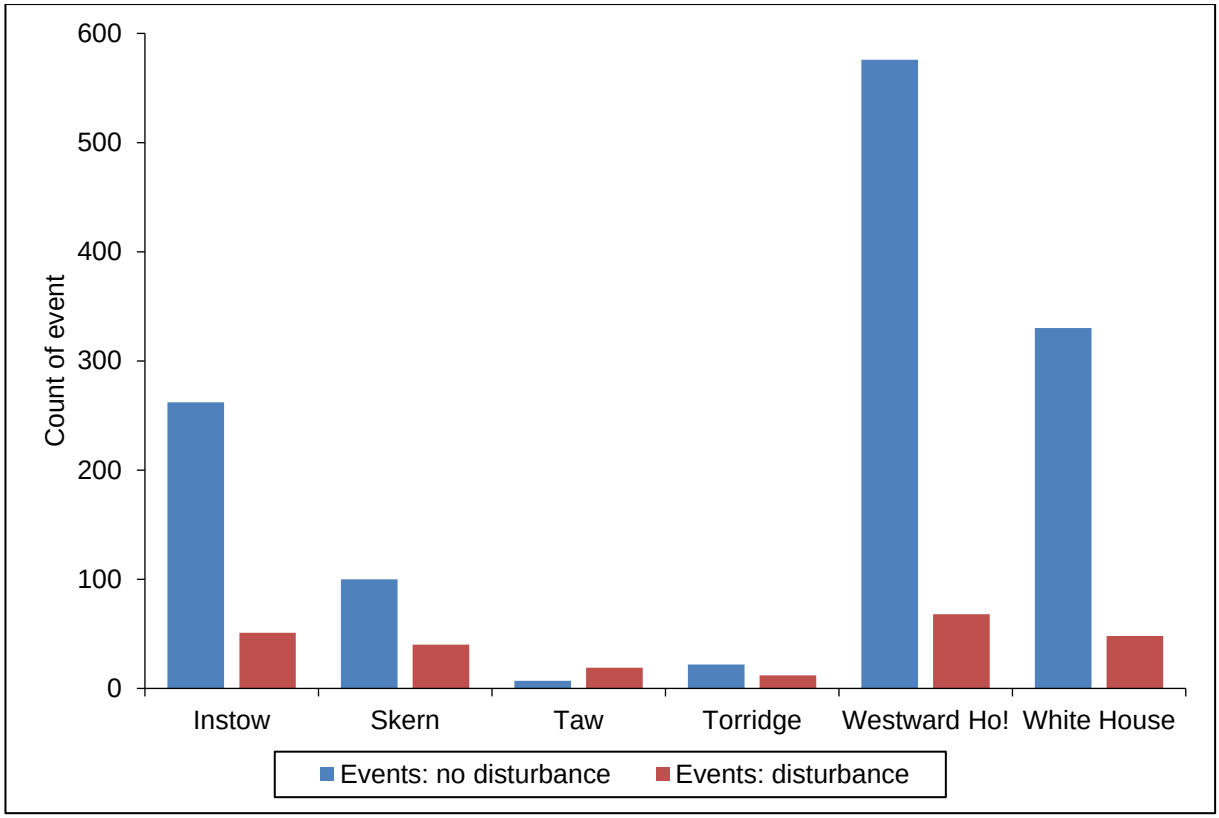

Figure 63. Total number of events resulting in no disturbance (*n*=1297) and causing disturbance (*n*=238) at each study site in October 2018 to March 2019.

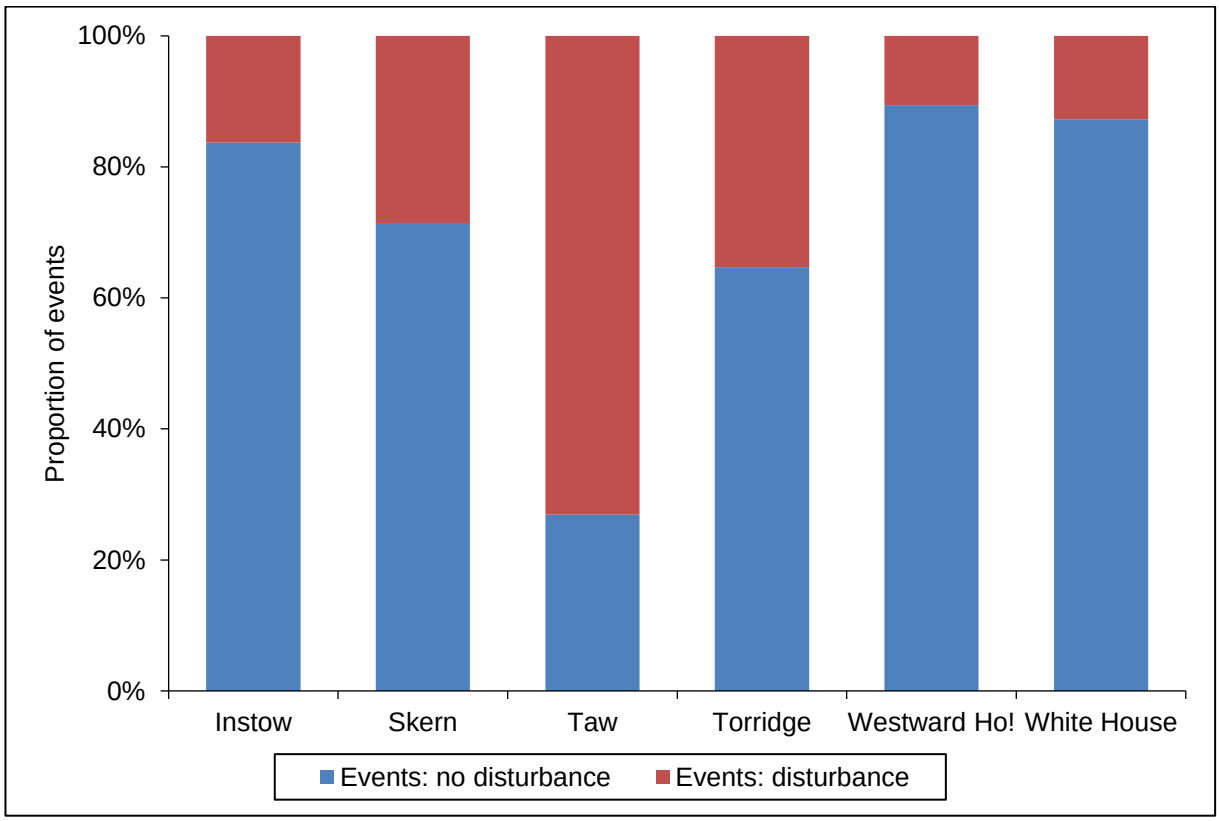

Figure 64. Proportion of all events resulting in no disturbance (*n*=1297) and causing disturbance (n=238) at each study site in October 2018 to March 2019.

Table 41. Details of the individual components of events that did not result in disturbance to WeBS species at all survey sites in October 2018 to March 2019.

	Instow	Skern	Taw	Torridge	Westward Ho!	White House	Total
Walker	423	205	8	6	969	645	2256
Dog off lead	322	95	4	1	622	359	1403
Dog on lead	5	7	0	0	17	7	36
Radio-controlled car	0	0	0	0	1	0	1
Jogger	8	0	0	0	30	7	45
Birdwatcher	1	0	0	0	0	0	1
Metal detectorist	1	0	0	0	0	0	1
Horse rider	0	1	0	0	0	2	3
Air traffic	1	0	1	2	0	0	4
Powerboat	2	0	0	1	1	1	5
Sailing boat	15	0	0	0	0	0	15
Gig row	1	1	0	7	0	0	9
Kayak/canoe/surf ski	7	0	0	3	1	0	11
Houseboat activity	0	0	0	2	0	0	2
Surfer	2	0	0	0	2	0	4
Wind surfer	8	0	0	0	1	1	10
Kite surfer	0	0	0	0	6	0	6
Kite buggy	0	0	0	0	1	0	1
Bait digger	1	0	4	0	0	2	7
Angler	2	0	6	0	0	0	8
Cyclist	0	0	0	0	0	3	3
Vehicle	3	0	0	0	0	1	4
Total	**802**	**309**	**23**	**22**	**1651**	**1028**	**3835**
Activity types	**16**	**5**	**5**	**7**	**11**	**10**	**22**

5.4.6 Looking in detail at the individuals involved in all events not resulting in disturbance at each site it is clear that walkers and dogs off the lead are widespread and abundant at the estuary mouth sites, but less so at the rivers Taw and Torridge where they are generally restricted to paths on the backshore. The greatest numbers of dogs off the lead were recorded from Westward Ho!, however, a higher dog to walker ratio was observed at Instow (Table 41).

5.4.7 A range of other activities are represented, although most are very rarely observed. The widest range of recreational activity not causing disturbance was observed at Instow where 16 event classifications were noted. The rivers Taw and Torridge, where pedestrian access to the intertidal zone is much reduced compared to the other sites, show a less varied profile of recreational activity involving far fewer events (Table 41).

5.4.8 Recreational activity event type observed at the Skern was highly restricted, and non-pedestrian events were extremely rare (Figure 65).

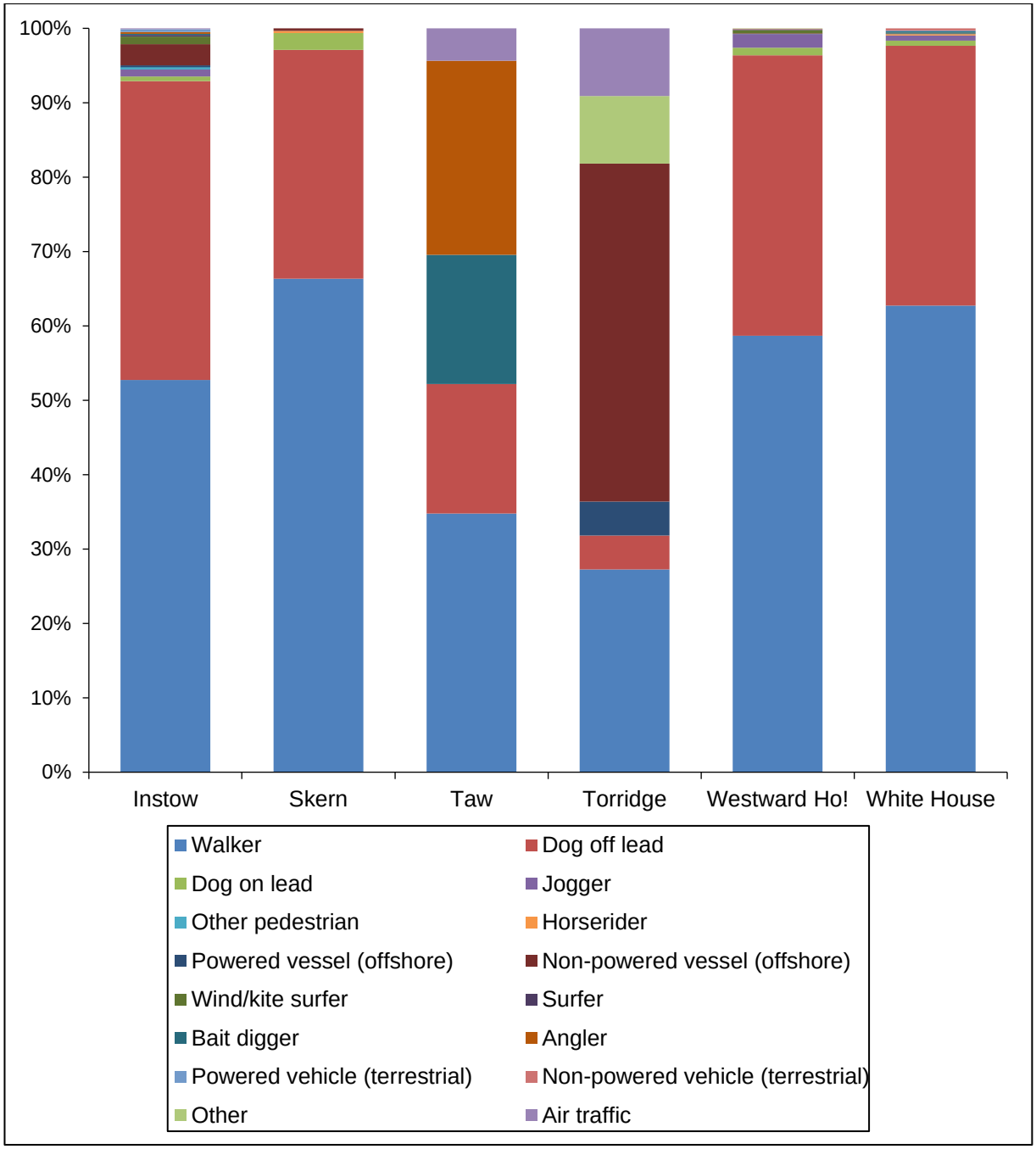

Figure 65. Proportions of component counts from recreational activity events that did not lead to a disturbance response in WeBS species (*n*=1297) at all study areas from October 2018 to March 2019.

Levels of disturbance and site level impacts on WeBS species

5.4.9 A plot of all recreational activity events occurring within each one-hour survey period against the mean count of individuals of all WeBS species present at each site throughout that period shows a general decline in the mean count of birds within the study area with increasing numbers of recreational activity events (Figure 66).

5.4.10 There appears to be a threshold relationship between the intensity of recreational activity and the numbers of birds. When the number of events in a one-hour period exceeds twenty the prospect of more than one-hundred individuals of WeBS species being present at the site is greatly reduced (Figure 66).

5.4.11 It is likely that that increased visitor access, regardless of the resulting levels of observable disturbance, diminishes a sites value to WeBS species though the level of effect is likely to be species and site specific.

5.4.12 It is possible that the general exclusion of birds that have learned certain sites are highly disturbed is a greater driver of reducing numbers than direct disturbance events leading to site evacuation.

5.4.13 For the more disturbed sites of Instow, Westward Ho!, White House and Skern, the mean WeBS count for each site visit, converted to a proportion of the maximum site count achieved for the tidal state during that visit (found to influence counts, Figure 61) and plotted against the total number of recreational activity events does not show a strong relationship (Figure 67). Variation in bird populations and distribution and levels of disturbance preceding the observed survey period are potential confounding factors, the latter being especially difficult to account for.

5.4.14 Overall it appears that increasing levels of site access for recreational activity can be expected to lead to a general reduction in the numbers of WeBS species at that site. The site-specific area utilised by recreational activities in comparison with the areas used by feeding and roosting of birds will be a key driver of the level of effect. This introduces the possibility that in some circumstances, especially at expansive sites, there could be ‘room’ for both birds and recreational activity. However, at small sites (including those made so by tidal inundation), recreational activity is likely to be incompatible with a high level of use by feeding and roosting birds.

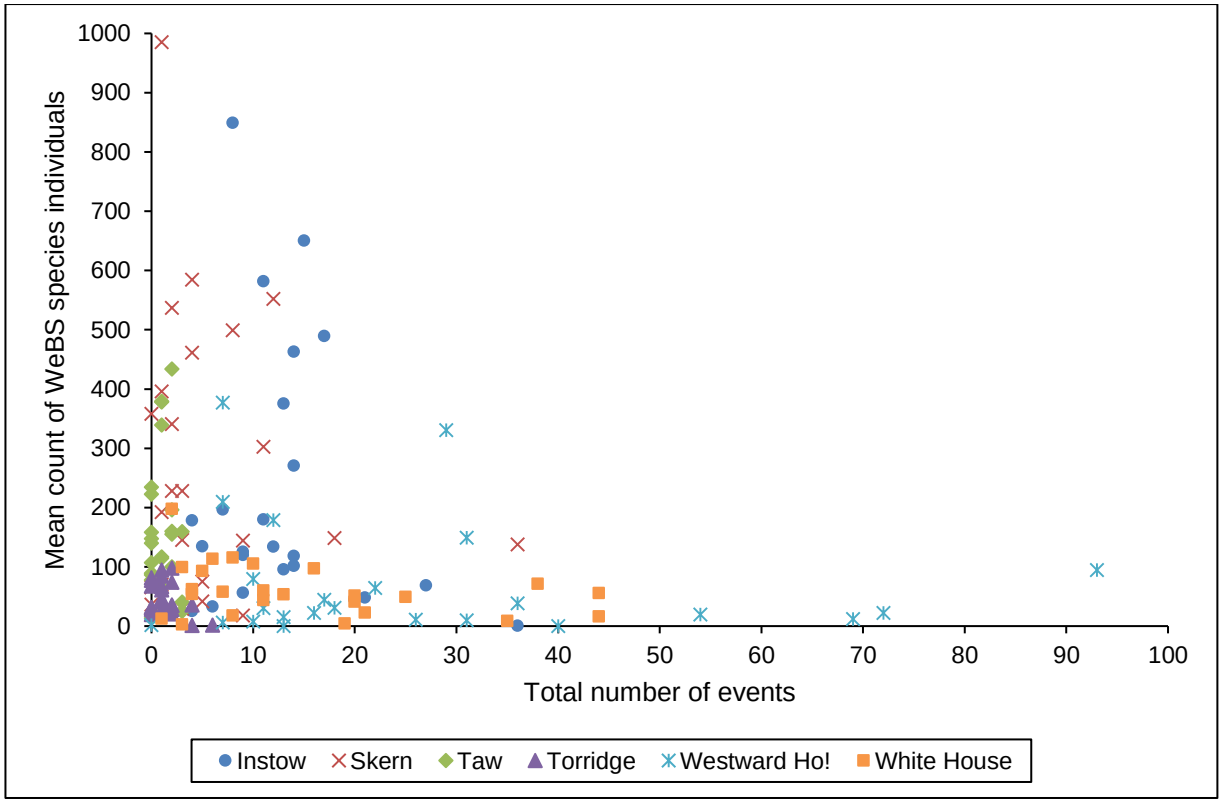

Figure 66. Mean count of individual birds of all WeBS species related to recreational activity events at all sites from October 2018 to March 2019.

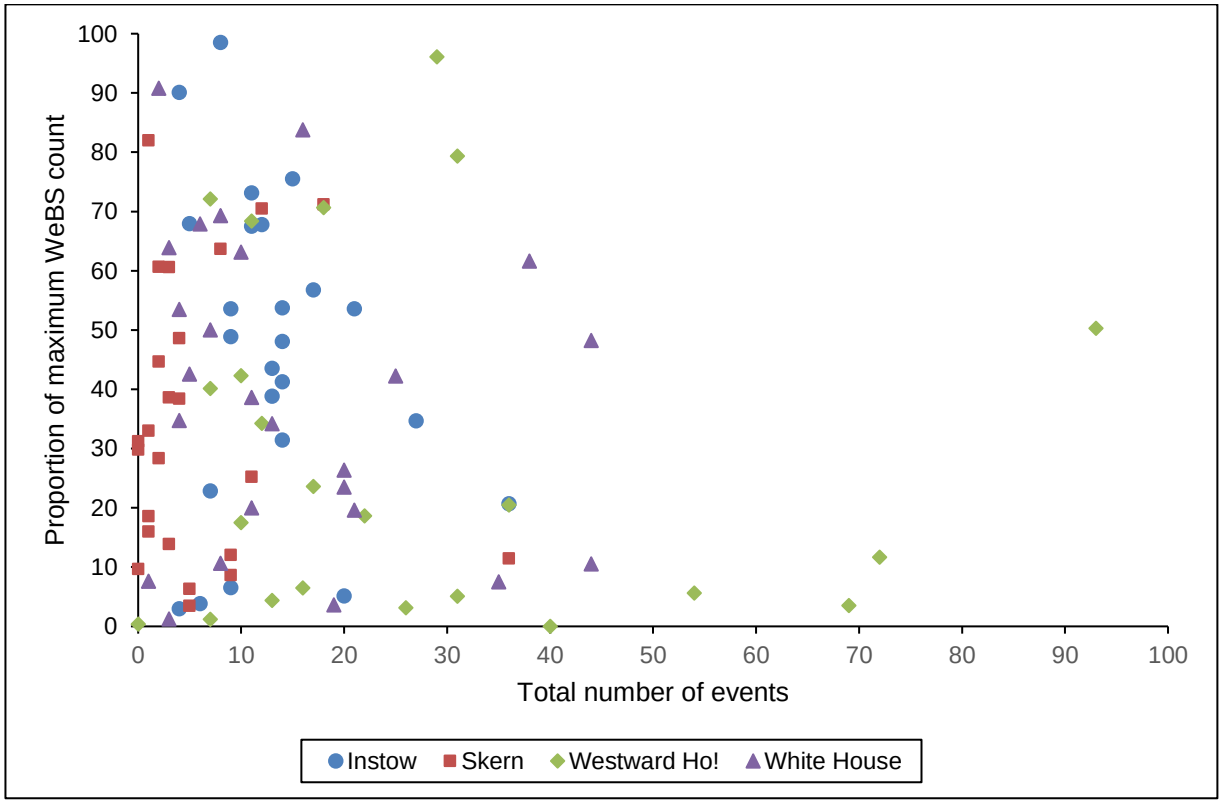

Figure 67. The number of WeBS birds present at each site as a proportion of the relevant maximum WeBS site count (at ebb, low, flood or high tide), related to recreational activity events in October 2018 to March 2019.

Recreational activity events causing disturbance

5.4.15 A total of 238 recreational activity events (Table 42) led to the disturbance of 27 WeBS species across all surveyed sites, resulting in 617 responses involving 11,245 individual birds. (The latter total accounted for duplicates and discounted them from the count wherever possible).

Table 42. Counts of events by category that resulted in disturbance to WeBS species at all survey sites in October 2018 to March 2019.

	Instow	Skern	Taw	Torridge	Westward Ho!	White House	Total
Walker & dog off lead	42	24	8	1	59	35	169
Walker & dog on lead	0	2	1	2	0	1	6
Walker	2	9	1	5	6	3	26
Jogger	1	0	0	0	2	1	4
Survey staff	1	0	3	1	0	3	8
Birdwatcher	0	2	0	0	0	1	3
Powerboat	1	0	0	0	0	0	1
Gig row	1	1	2	0	0	0	4
Kayak/canoe/surf ski	1	0	2	1	0	0	4
SUP	0	0	0	1	0	0	1
Surfer	1	0	0	0	0	0	1
Bait digger	2	0	0	2	0	3	7
Angler	0	0	2	0	0	0	2
Cyclist	0	0	0	0	0	1	1
Vehicle	0	1	0	0	0	0	1
Total	**52**	**39**	**19**	**13**	**67**	**48**	**238**

5.4.16 Walkers with dogs off the lead caused the overwhelming majority of the observed disturbance events (Table 42).

5.4.17 The highest proportion of events leading to disturbance attributed to walkers with dogs off the lead was observed at Westward Ho! followed by Instow and the White House, where a slightly more varied recreational profile was recorded (Figure 68).

5.4.18 The lowest proportions of events leading to disturbance attributed to walkers with dogs off the lead (and overall) are noted at the Taw and Torridge sites (Figure 68), although pedestrian traffic still accounted for the majority of disturbance caused at both sites, despite the more limited access to intertidal habitat.

5.4.19 Disturbance from offshore activity was rare, and notably, no disturbance was observed from kite surfers or wind surfers (Table 42). Kite surfing particularly is known to be a potentially significant disturbing activity (Thorsten, 2018). There appears to be minimal conflict with wintering birds on the TTE, although the Instow and White House areas may be considered to be at risk if kite surfing activity increases in the future.

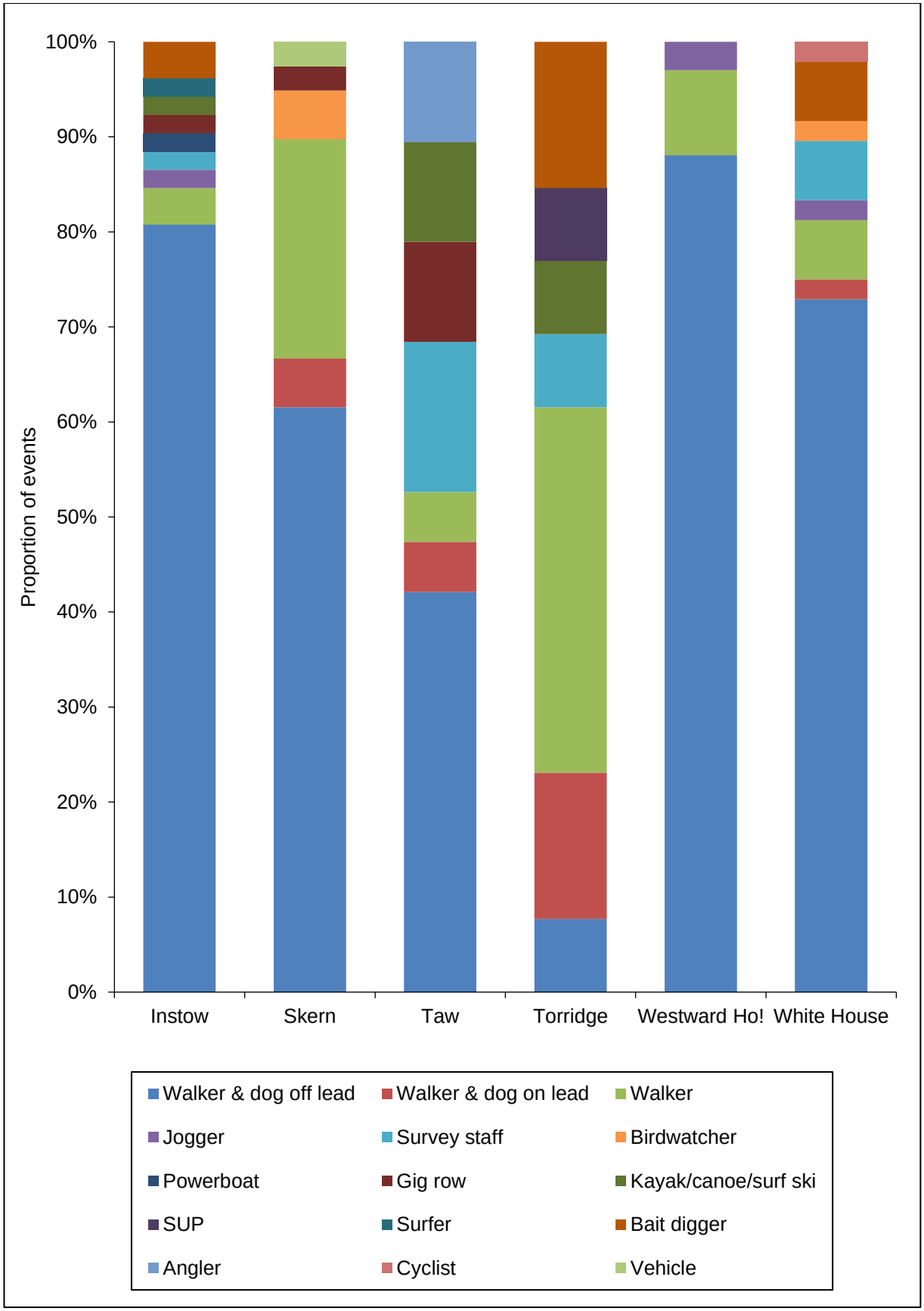

Figure 68. Proportions of recreational activity event categories causing disturbance responses (at all levels from 1-5) in WeBS species (*n*=238) at all study areas from October 2018 to March 2019.

Table 43. Counts of individual birds disturbed at each study site by species.

	Instow	Skern	Taw	Torridge	Westward Ho!	White House	Total
Bar-tailed Godwit	0	1	0	0	0	0	1
Black-necked Grebe	0	0	0	0	0	1	1
Black-tailed Godwit	24	0	4	0	0	0	28
Brent Goose	12	426	0	0	199	19	656
Canada Goose	0	0	170	0	0	0	170
Cormorant	0	0	35	0	0	0	35
Curlew	31	71	82	5	23	73	285
Dunlin	0	233	0	0	0	36	269
Eider	0	2	0	0	0	0	2
Golden Plover	0	500	0	0	2289	0	2789
Goosander	0	0	8	0	0	1	9
Greenshank	0	0	0	0	0	2	2
Grey Heron	1	0	0	4	5	0	10
Grey Plover	2	1	0	0	0	4	7
Lapwing	0	247	181	0	0	0	428
Little Egret	3	3	4	1	6	6	23
Mallard	0	0	17	0	0	214	231
Oystercatcher	3052	165	87	2	725	506	4537
Pintail	0	10	0	0	0	0	10
Redshank	9	63	35	2	0	20	129
Ringed Plover	75	1	0	0	0	15	91
Sanderling	42	0	0	0	282	0	324
Shelduck	0	33	31	7	2	8	81
Snipe	0	5	10	0	0	0	15
Teal	0	2	0	47	0	0	49
Turnstone	7	0	0	0	0	0	7
Wigeon	286	451	0	24	0	295	1056
Total individuals	**3544**	**2214**	**664**	**92**	**3531**	**1200**	**11245**
WeBS species count	**12**	**17**	**12**	**8**	**8**	**14**	**27**

5.4.20 A total of 27 WeBS species were observed being disturbed by recreational activity (Table 43). The highest number of individuals disturbed was reported at Instow where a total of 3,544 birds of WeBS species were observed being disturbed. Oystercatcher accounted for 86% of the individual birds disturbed at Instow (Figure 69).

5.4.21 Of the 3,531 individual birds disturbed at Westward Ho! Golden Plover (65%) and Oystercatcher (21%) were most numerous, although the latter were involved in a greater number of the events observed.

5.4.22 Golden Plover tend to be observed in large flocks and therefore any disturbance to this species is likely to affect many individuals.

5.4.23 Although the Taw and Torridge sites were similarly undisturbed in terms of the numbers of events (Table 42) many more individual birds were observed exhibiting disturbance response behaviour on the river Taw (Table 43) as a result of the much greater numbers of birds present (Table 39).

5.4.24 The most diverse range of species disturbed was seen at Skern (Table 43), where Golden Plover, Wigeon and Brent Goose accounted for the greatest numbers of individual birds exhibiting disturbance response behaviour (Figure 69).

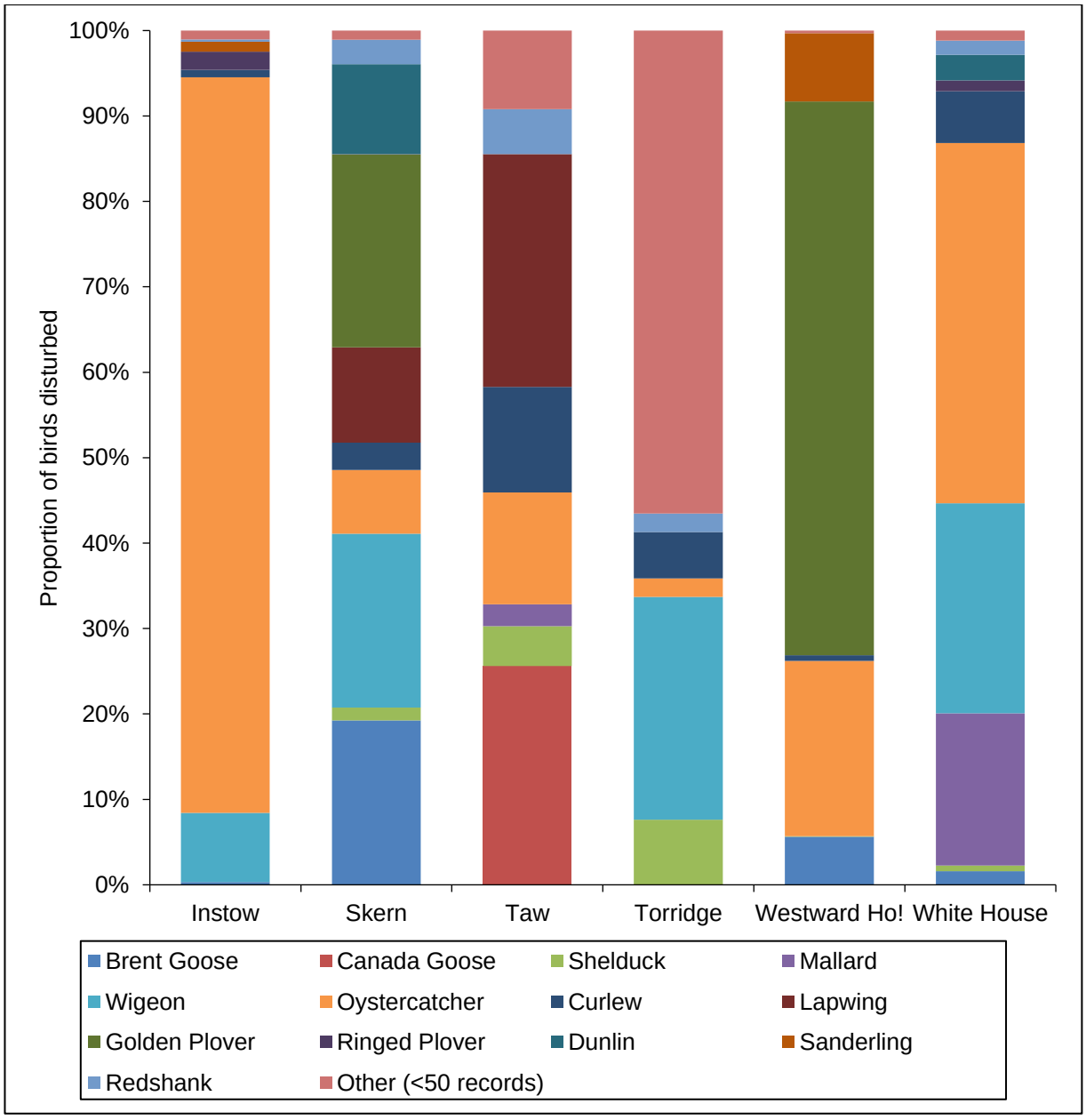

Figure 69. Proportions of species (≥50 records) disturbed at all study areas from October 2018 to March 2019.

5.4.25 The total number of disturbance responses observed generally increases with the total number of events across all sites, although the relationship is weak. On many occasions, the number of events is exceeded by the number of disturbance responses observed (Figure 70).

5.4.26 At sites such as Westward Ho! the area used by walkers is at least partially influenced by the levels of access. For example, if the upper beach is very busy at low tide, more walkers may decide to access remote areas of intertidal habitat, where there is increased potential for interaction with birds. Upon doing so it is likely that multiple disturbance responses will be initiated.

5.4.27 It is inevitable that there is a level of site access at which disturbance responses are no longer observed and total exclusion occurs.

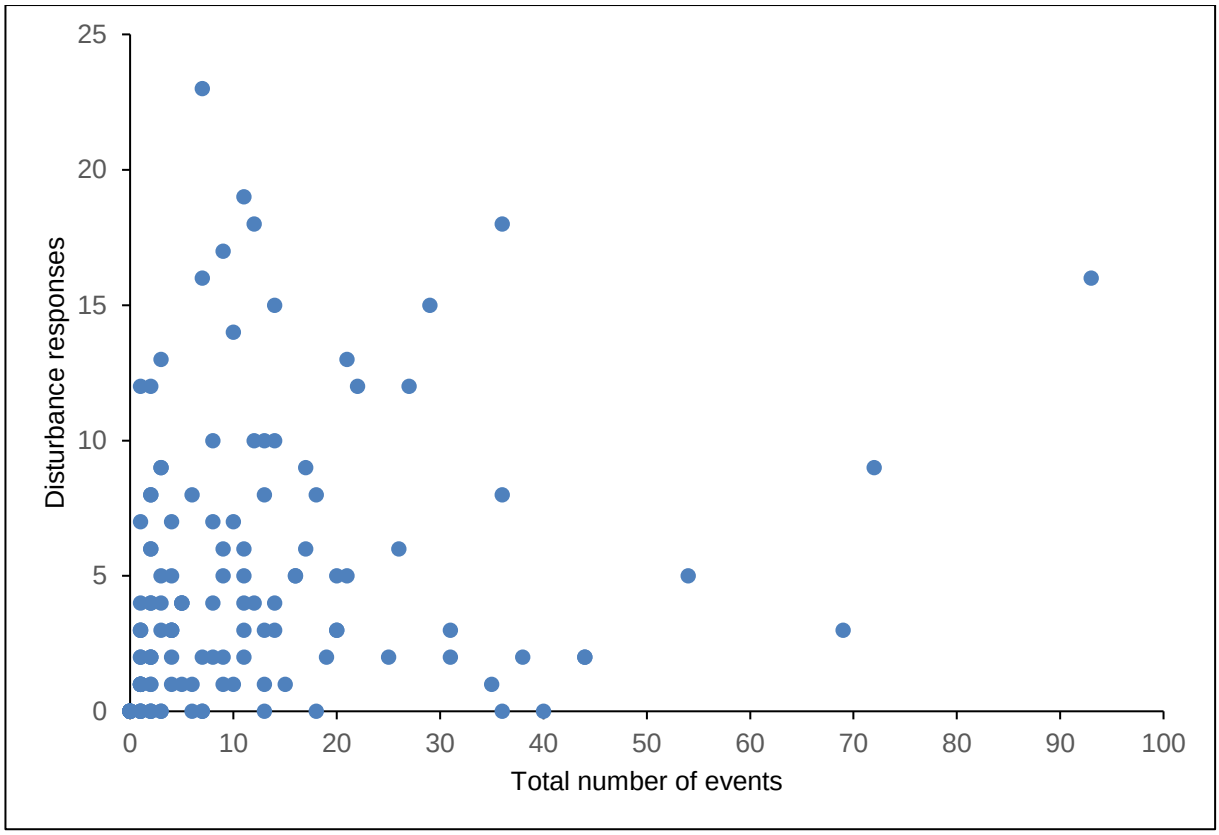

Figure 70. Scatter plot showing relationship between the total number of recreational activity events (*n*=1535) and the number of disturbance responses at all sites from October 2018 to March 2019.

5.4.28 There are site specific differences in rates of access, and the resulting rates of disturbance to WeBS species (Table 44). As survey work covered all times of day and environmental conditions these rates are considered scalable to provide an estimated daily rate.

5.4.29 The rates of disturbance calculated give the impression of generally high levels of disturbance, in terms of the numbers of events and the counts of birds involved. Instow and Westward Ho! are clearly the most problematic sites, with high numbers of birds being disturbed very frequently (Table 44).

5.4.30 High disturbance rates despite lower access rates at Skern expose the problem of pedestrian access at a more restricted intertidal area where conflict with feeding or roosting birds is more likely (Table 44).

Table 44. Hourly (hr) rates of total events, disturbance causing events, responses to disturbance and numbers of WeBS species birds (count of individuals) responding to events.

Site	Hours of observation	Total events per hr	Events causing disturbance per hr	Disturbance responses per hr	Number of individual bird responses per hr
Instow	24	13.04	2.13	5.71	221
Skern	24	5.83	1.67	4.50	96
Taw	25	1.04	0.76	2.88	27
Torridge	24	1.42	0.50	1.00	4
Westward Ho!	24	26.83	2.83	7.79	154
White House	25	15.20	1.92	3.56	49
Total	**146**	**10.55**	**1.63**	**4.23**	**91**

5.4.31 A number of factors must be considered to assess the severity of disturbance events. While it is useful to consider these events in terms of the direct disturbance responses, and the numbers of birds being disturbed, there may also be less readily observed effects and impacts.

5.4.32 It is highly likely that a level of exclusion occurs at some sites in accordance with an overall level of recreational activity, and this may also be influenced by ongoing levels of disturbance response. Assessing true levels of exclusion is beyond the scope of this methodology.

5.4.33 Observable responses, at all levels, to disturbance at the individual bird level were noted at all sites, and the most frequently observed response was a flight of >50m with the bird(s) remaining within the site (Figure 71).

5.4.34 Caution should be exercised in assessing the severity of the response depending on the level of action taken as a multitude of factors will influence the probability of any overall impact. Specifically, it is not clear that taking flight to access another area of undisturbed habitat is likely to have a greater detrimental impact to birds than frequently entering an ‘alert’ state where feeding or resting is disrupted.

5.4.35 It might reasonably be assumed that birds being forced to leave a site due to disturbance is a negative outcome, as is any regular or prolonged deviation from normal behaviour. The likelihood of negative consequences for birds will inevitably increase with the frequency and longevity of response behaviours.

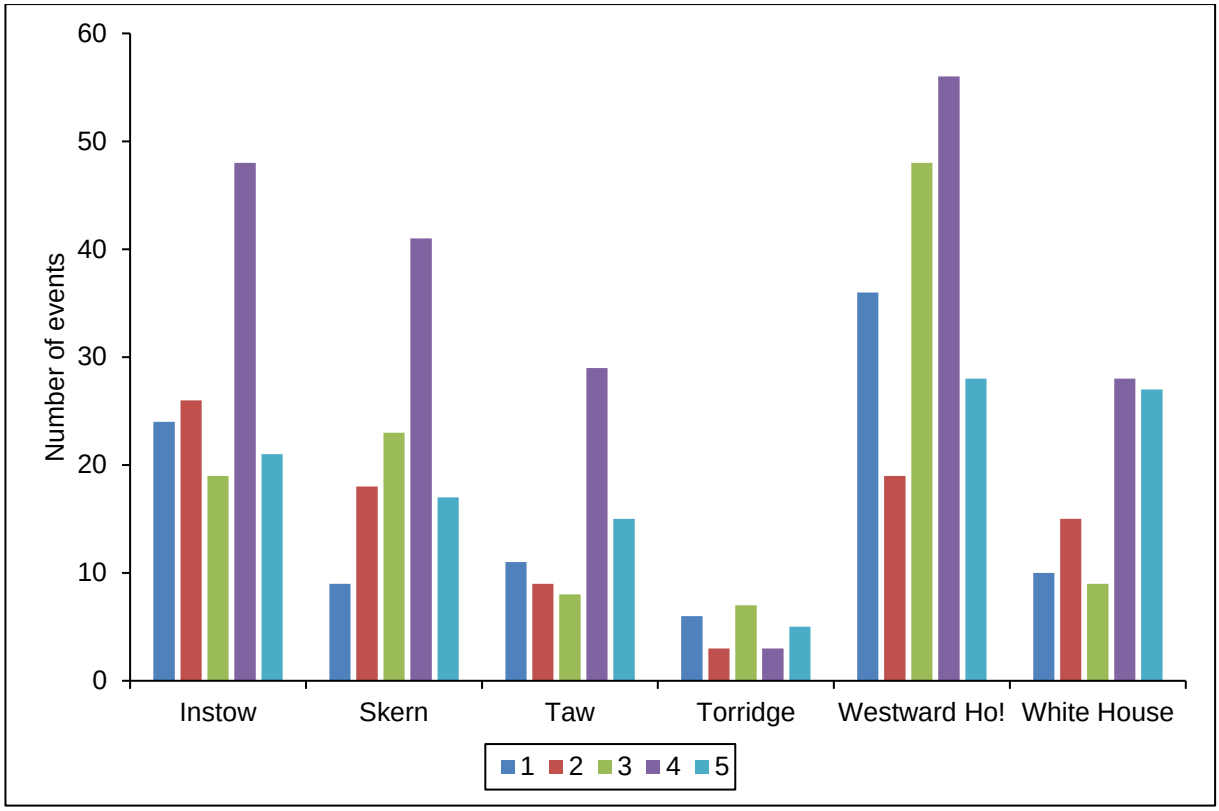

Figure 71. Number of recorded response events (*n*=238) at each disturbance category (1-5) at each survey site in October 2018 to March 2019. (refer to table 36)

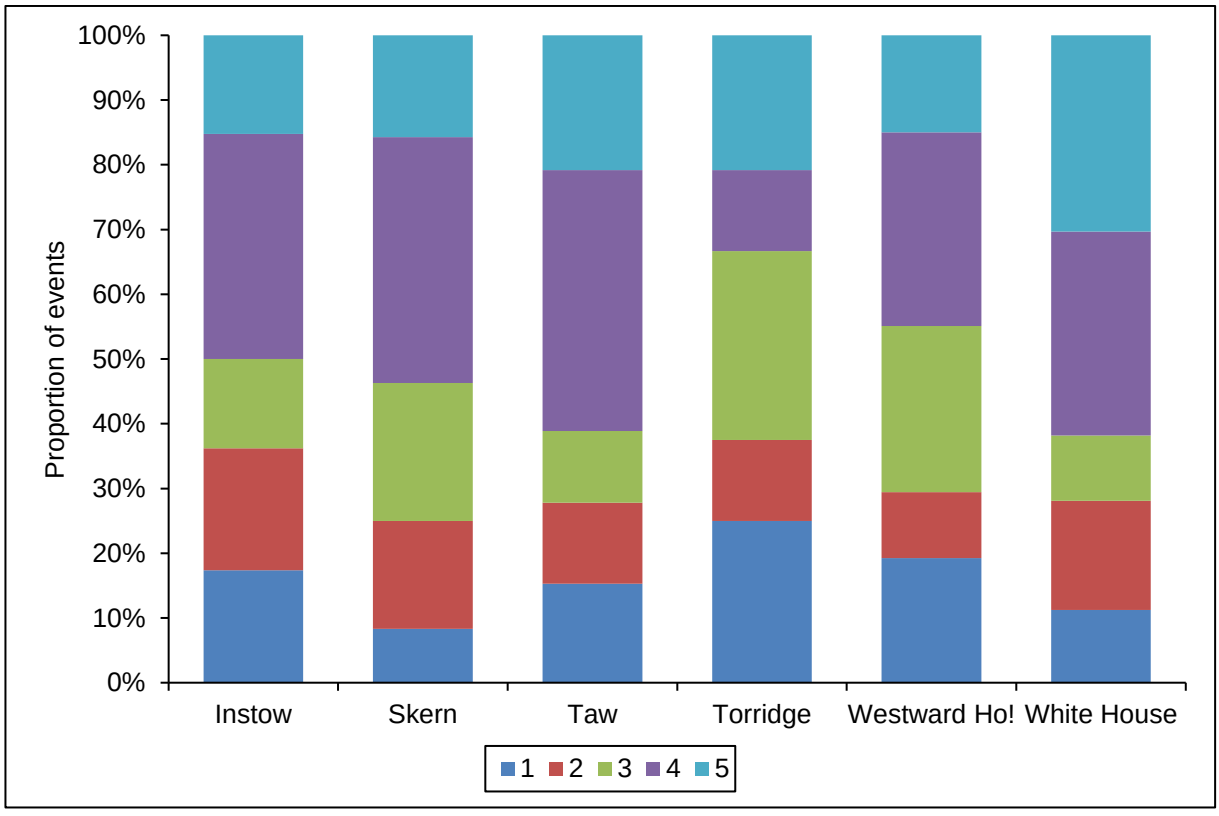

Figure 72. Proportion of recorded response events in each disturbance category (1-5) at each survey site in October 2018 to March 2019 (refer to table 36).

5.4.36 The proportion of disturbance events resulting in the complete abandonment of the site (level 5) is highest at the White House site (Figure 72). This may be due to the relatively restricted area of habitat available to birds and the spread of recreational activity in the vicinity of that habitat.

5.4.37 Overall, disturbance effects involving flight are most frequently observed (Figure 71 & 72). These responses have an energetic cost in addition to the loss of foraging or resting time, which has implications for the likely overall impacts of disturbance.

5.4.38 The disturbance responses observed to different events appear broadly similar, although comparatively little data was collected for events other than walker(s) with dog(s) off the lead (Figure 73).

5.4.39 Walker(s) with dog(s) off the lead caused more incidences of complete site evacuation than other pedestrian traffic events, including walkers with dogs on the lead. Low level responses to walkers with dogs on leads were more frequently observed, although somewhat counter-intuitively this was not the case for unaccompanied walkers (Figure 73).

5.4.40 Disturbance events occurred over all intertidal habitat at all sites. Focusing on pedestrian events (some of which cause disturbance at multiple habitat types) walkers with dogs off the lead were observed disturbing birds across the intertidal zone (Figure 74).

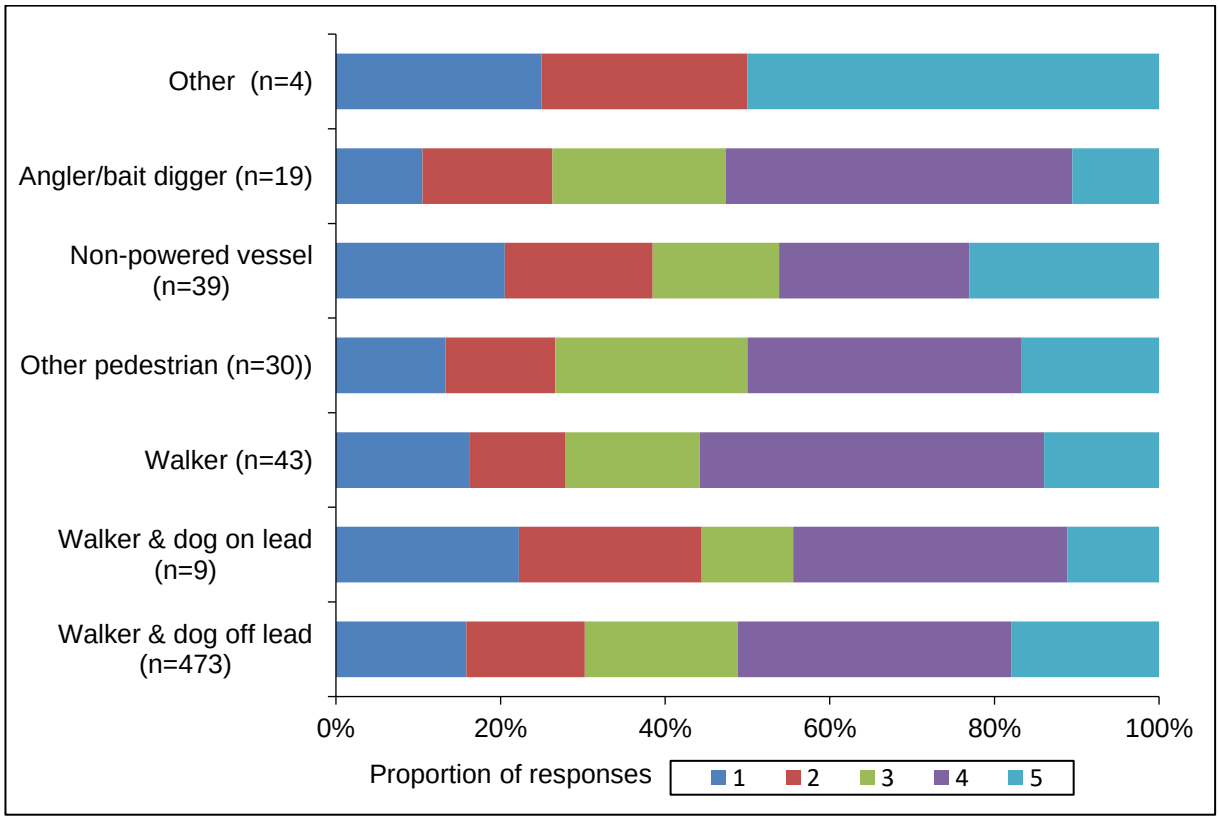

Figure 73. Proportion of responses (n=617) at each level to different event categories (number of responses to each in parentheses) (refer to table 36).

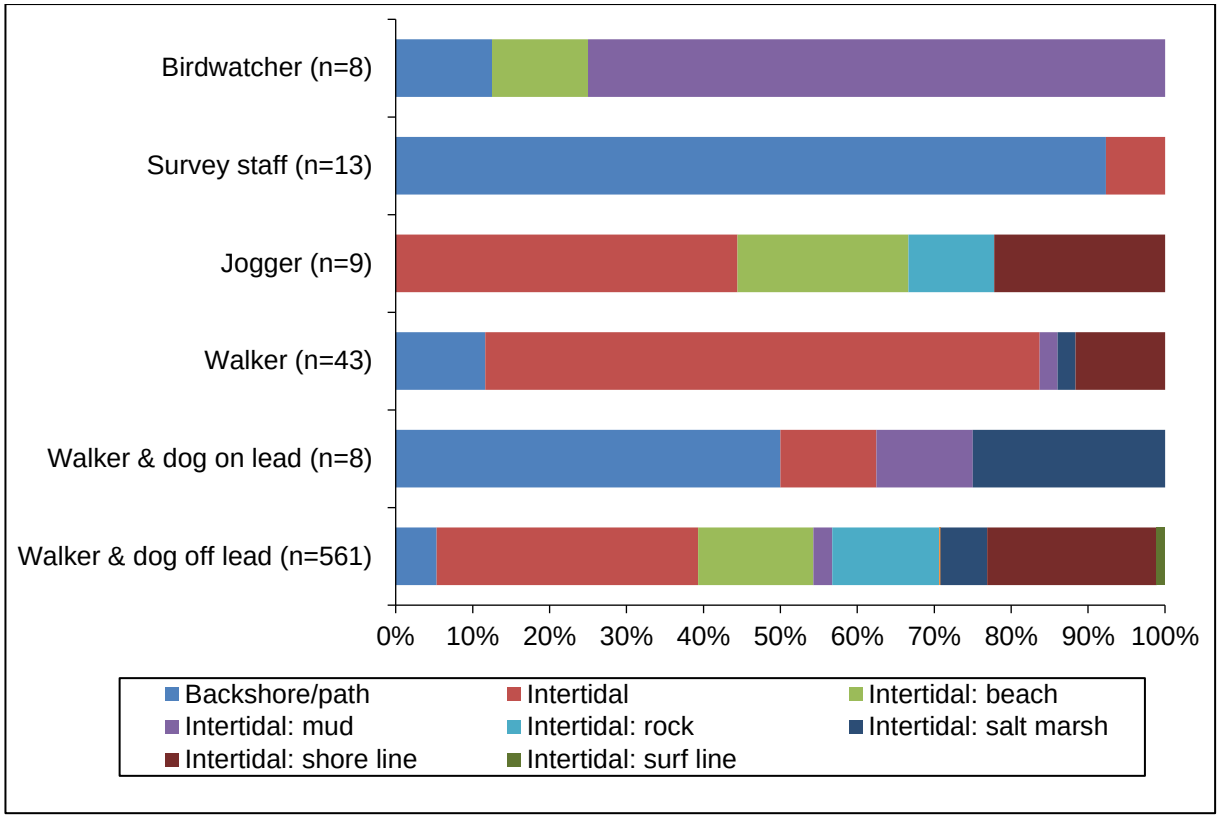

Figure 74. Proportions of disturbance causing pedestrian based events occurring at different habitat types at all sites in October 2018 to March 2019.

5.4.41 Species-specific differences in the observed responses to disturbance are apparent. Lapwing are found to be most likely to abandon a site completely (Figure 75). This may be due to a preference for non-tidal habitat, meaning that abandoning inter-tidal habitat comes at little cost. Grey Heron, Redshank, Curlew and Snipe *Gallinago gallinago* were also frequently observed to abandon a site. It is not clear if this response is driven by increased sensitivity to disturbance or a lower cost of the action compared to other species.

5.4.42 A general and well-known difference between wildfowl and wader response is apparent, with the latter being more likely to undertake flight responses to disturbance events while the former, for whom taking flight is more taxing, may walk or swim away (Figure 75).

5.4.43 Considering wildfowl, Canada Geese and Mallard appear to be the least sensitive to disturbing events, with no records of birds taking flight in response. By contrast, Brent Geese and Shelduck were frequently observed undertaking major flights or evacuating sites completely. Teal and Wigeon were less likely to evacuate a site, but did utilise flight responses at a similar level.

5.4.44 Sanderling are usually seen to make short flights in response to disturbance (Figure 75), and will often continue foraging immediately upon landing, however, many such flights may be made. On one occasion at Westward Ho! >100 short flight responses to a dog off the lead were recorded in a 14-minute period. This

pattern of disturbance is known to reduce the foraging success of the species (Gray, 2006).

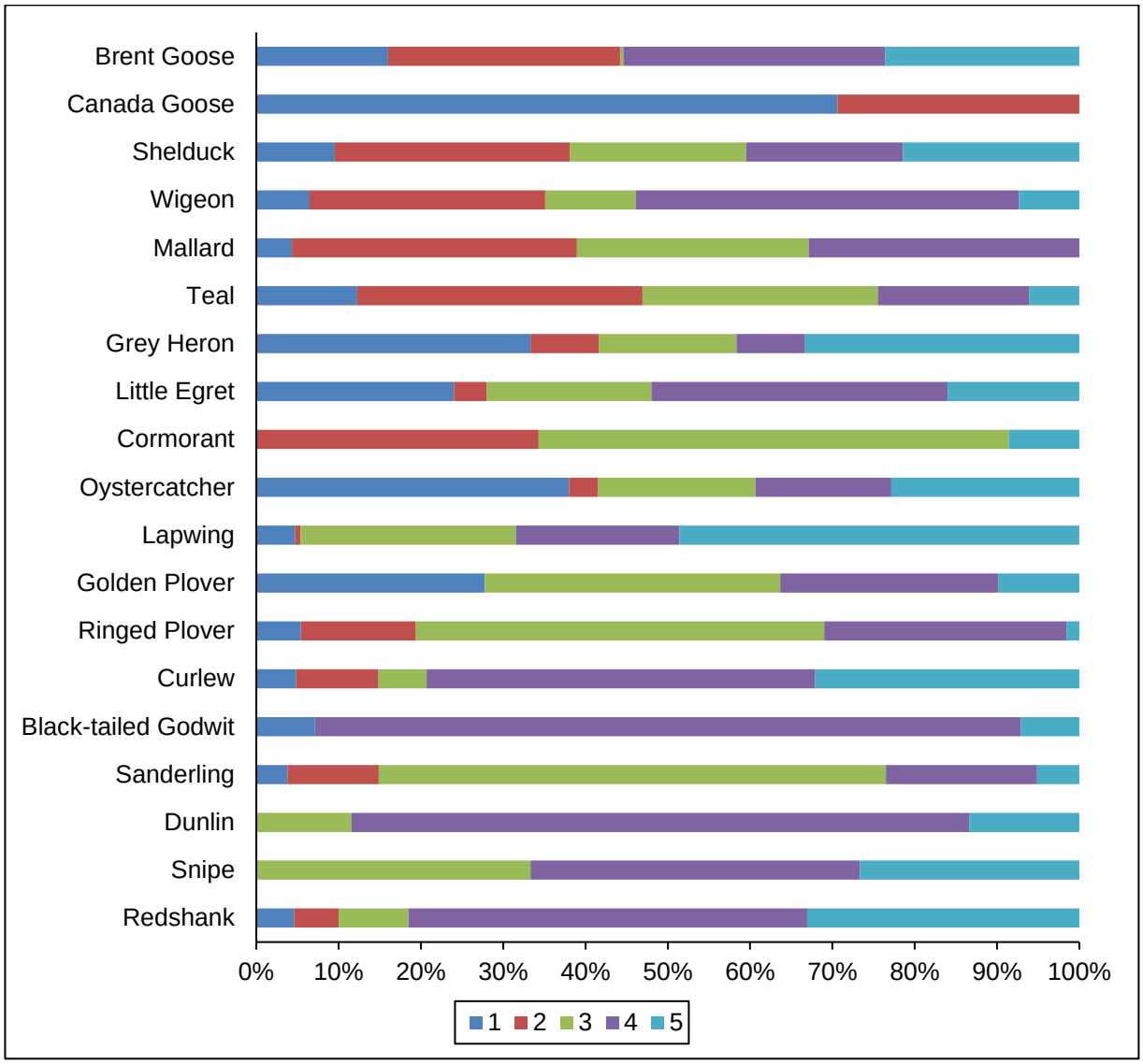

Figure 75. Proportion of disturbance responses of all species where >10 individuals were recorded exhibiting a response behaviour at all survey sites in October 2018 to March 2019 (refer to table 36).

5.4.45 When investigating the proximity at which recreational activity may impact birds a general approach was taken. It is considered too great a risk to generate site or species-specific recommendations on setback distances for specific recreational activities due to the highly variable nature of observations and influencing factors.

5.4.46 The limited data collected on air traffic was excluded from analysis. Some of this activity was regarded as recreational, however, it is not relevant to the usual profile of recreational use of the estuary and could not be incorporated into any future management or mitigation “on the ground”. Suffice to say that far greater response distances were observed to air traffic, although from the very limited number of observations, these responses do not appear consistent.

5.4.47 Although mean proximities at which disturbance responses were noted are presented (Figure 76), a precautionary approach would be recommended that considers the maximum response distances (Figure 77) as the baseline for all WeBS species.

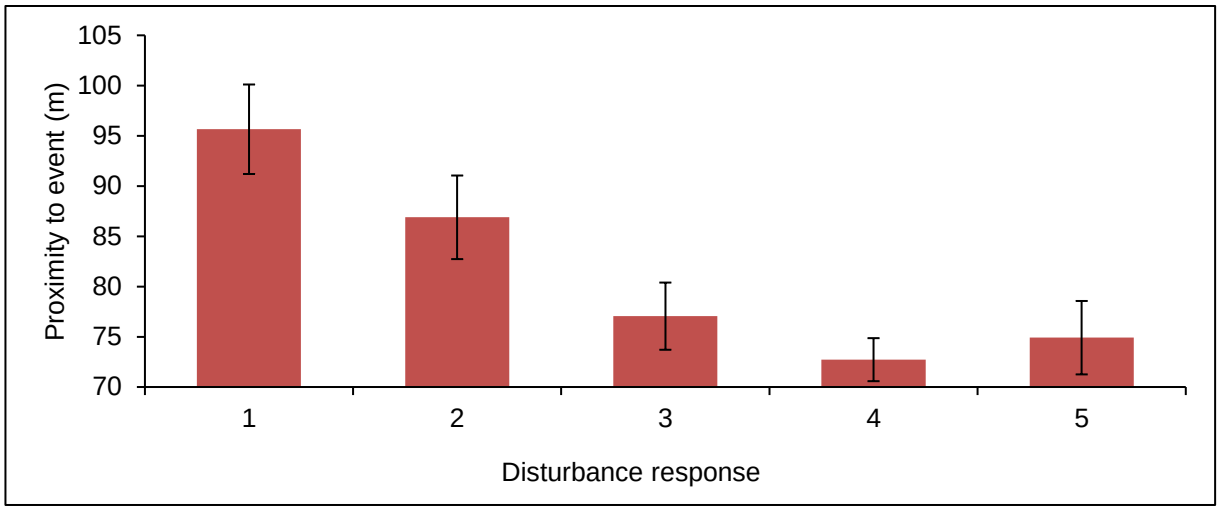

Figure 76. Mean proximity (m) with ± 1 standard error to causal event for each disturbance response category across all species at all sites (*n*=611) (refer to table 36).

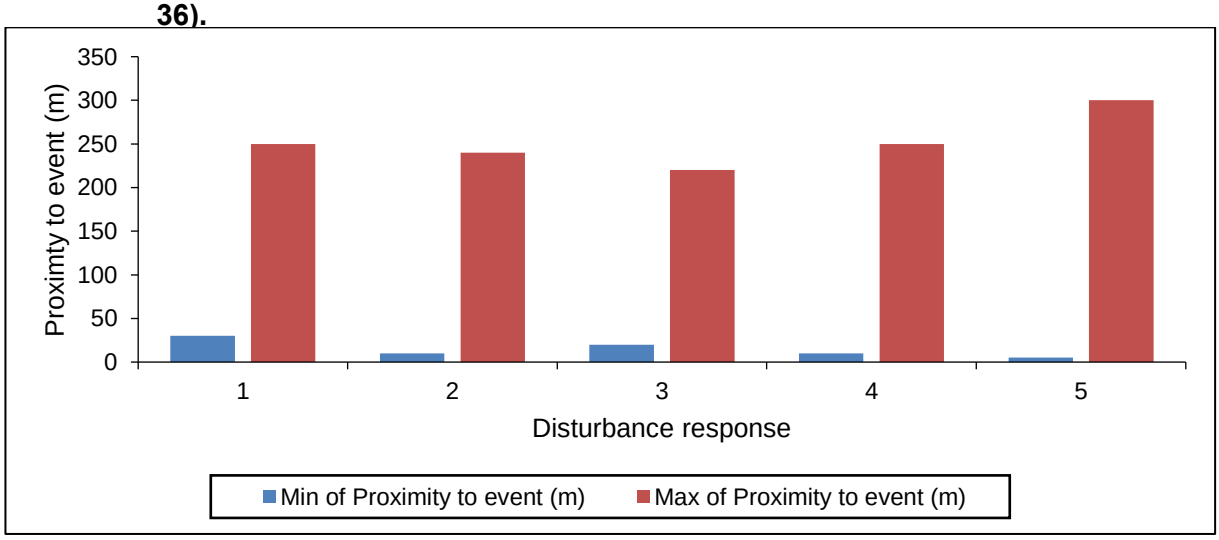

Figure 77. Minimum and maximum disturbance response initiation (m) distances for each disturbance response category across all species at all sites (*n*=611). (refer to table 36)

5.4.48 The mean proximity to event declines with the severity of response (Figure 76), as might be expected. A mean distance of 96 m with a standard error of 4.5 m would suggest a baseline distance of 100 m at which recreational activity is likely to affect birds.

5.4.49 However, the maximum proximity for all response levels range from 220 m to 300 m (Figure 77). It should be noted that responses at this distance are rare. However, the inherent difficulty in observing and assessing behaviour as being initiated in response to an event at this distance may be a factor and could lead to under-recording.

5.4.50 It is of note that most studies of this nature (E.g. Liley and others, 2011) have usually considered a 200 m distance from events as the sphere of potential influence, and record responses of birds falling within that range.

5.4.51 To consider the likely impacts of disturbance on wintering birds their pre-disturbance behaviour is of particular relevance. The proportions of events effecting all WeBS birds as defined by their pre-disturbance behaviour are plotted at all study sites (Figure 78).

5.4.52 At Instow, roosting birds are most disturbed (Figure 78) due to the large Oystercatcher roost combined with the increased chance of interaction with walkers at close proximity to the roost area during high tide. Roosting birds at the White House are similarly affected.

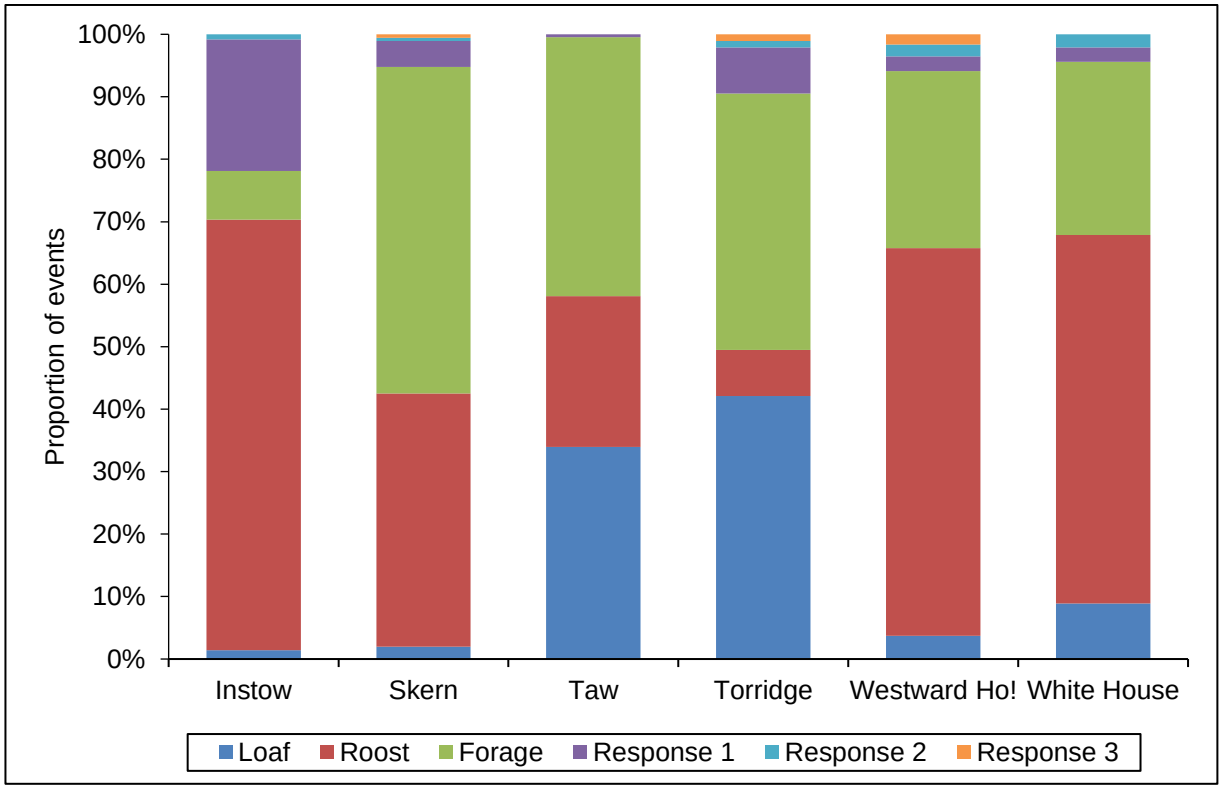

Figure 78. Pre-disturbance behaviour of disturbed birds (*n*=14089) (refer to table 36).

5.4.53 At Westward Ho! roosting birds are again the most frequently affected (Figure 78), although here it is Golden Plover at low tide driving the trend.

5.4.54 At Skern, despite the significant high tide roost, foraging birds account for more individual disturbance responses (Figure 78). This highlights the impact of pedestrian traffic using the low tide SWCP route on the birds utilising the intertidal area for foraging.

Cumulative impacts and exclusion

5.4.55 Conclusive evidence of the cumulative nature of disturbance on the TTE could not be provided in this study. Nonetheless, a number of general points and their potential consequences for birds can be made.

5.4.56 On occasion, events that confirm that recreational activity can exclude WeBS species from a site were recorded (Table 45).

Table 45. Summary descriptions of events where clear exclusion of newly arrived WeBS species from the study area was observed.

Site	Event	Event location	Event length (mins)	Species	Count	Behaviour	Proximity to event (m)
Westward Ho!	2 walkers & 2 dogs off lead, (foraging?)	Inter-tidal: Beach, rocks/cobbles	39	Golden Plover	2000	In flight. Attempting to land	100
White House	6 walkers & 4 dogs off lead	Intertidal: shoreline, in water, on saltmarsh	20	Dunlin Grey Plover Curlew	180 12 21	Flushed from Yelland. Attempting to land. To Skern.	200
Westward Ho!	2 walkers & 2 dogs off lead	Inter-tidal: Beach, rocks/cobbles, shoreline	>30	Brent Goose	36	In flight. Attempting to land (5 minutes) Landed offshore (swam in later)	100
White House	6 walkers & 2 dogs off lead	Intertidal: beach, edge of saltmarsh	-	Shelduck	2	In flight. Attempting to land. To Skern.	80
Instow	2 surfers & 1 surf ski paddle	Offshore: surf zone Black Ground	>60	Oystercatcher	100	In flight. Attempting to land.	100
White House	Constant traffic (walkers & dogs off lead)	Intertidal: beach, saltmarsh	>60	Wigeon	31	In bay, attempting to swim onto edge of saltmarsh	100

5.4.57 Confirmed observations of disturbed birds relocating to other sites during disturbance monitoring surveys were relatively rare (Figure 79). However, the likely relocation areas for many high tide roosts were also identified (Section 3).

5.4.58 It is of note that birds disturbed from Skern appear unlikely to relocate to the Instow area, although it is possible that some birds observed heading inland may have done so. In contrast, it appears that birds disturbed from Instow will move to Skern.

5.4.59 It is plausible that wintering birds utilise sites according to a hierarchy based on roosting or foraging value with disturbance at individual sites ultimately structuring the use of these sites.

5.4.60 Due to the observational constraints of a single observer at a fixed location it is not possible to identify distant sites that birds relocate to. However, the destination of the majority of birds abandoning Instow, Westward Ho! and the White House was observed, with most remaining in the estuary mouth area, presumably due to habitat requirements. Reduced visibility from the Skern VP due to the local topography hindered observations.

5.4.61 Given the findings in relation to recreational activity in intertidal estuary mouth areas, it appears inevitable that once disturbed from one site, relocating birds will be at risk of further disturbance at other sites.

5.4.62 In terms of cumulative disturbance on the estuary it is clear overall that there is very little undisturbed habitat available to wintering birds, especially at high tide.

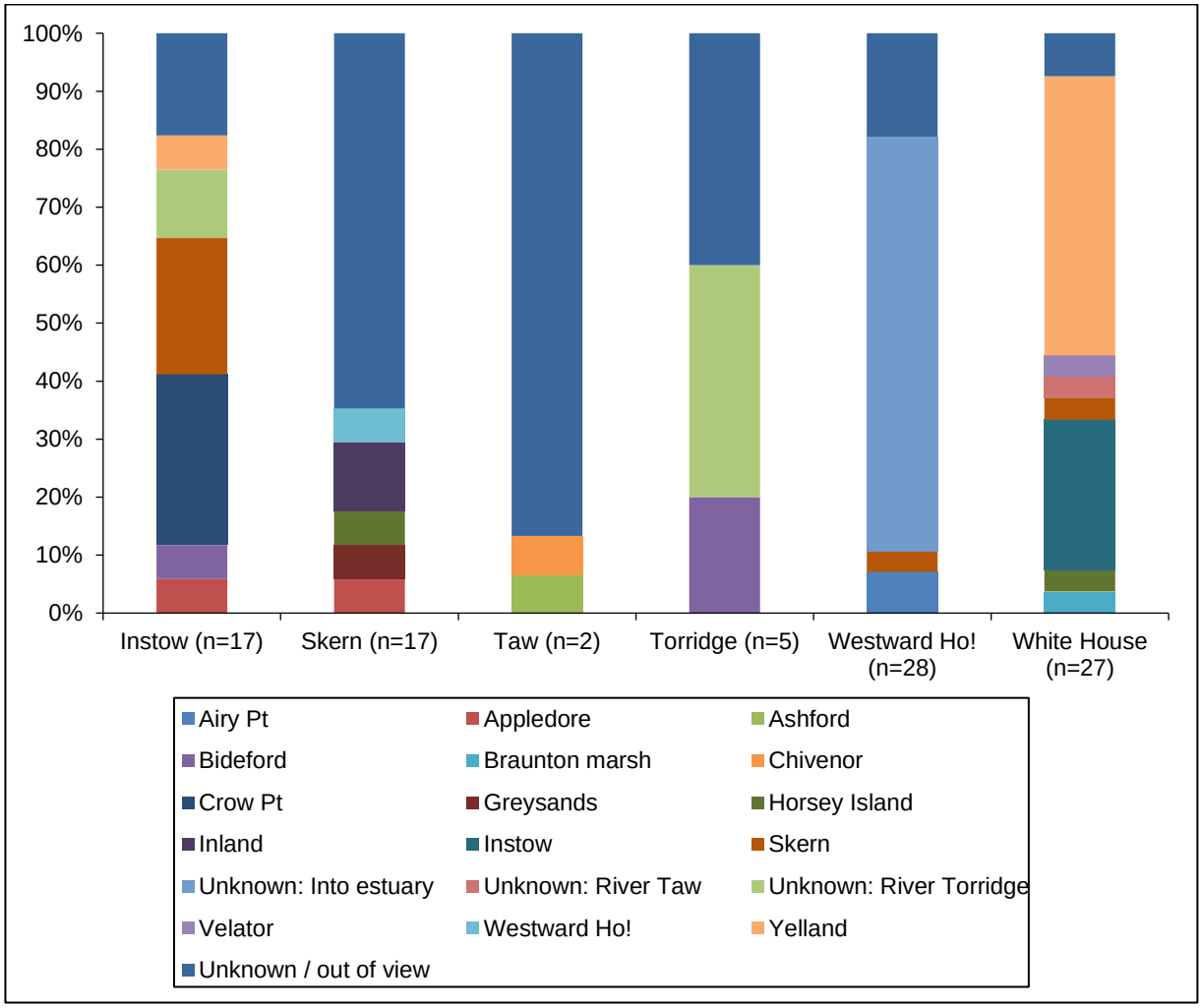

Figure 79. Disturbance responses resulting in observable relocation to another site within the estuary.

Non-recreational disturbance

5.4.63 Disturbance arising from non-recreational use of the estuary, surrounds, and air space was very rarely observed, although events could be significant.

5.4.64 Just five air traffic events comprising three helicopters and two planes, were recorded. On one occasion, a helicopter flying over the Penhill and Ashford area at low tide disturbed approximately 1,950 individuals of WeBS species from a distance of >1.5 km.

5.4.65 The retention of RMB Chivenor may lead to increased levels of air traffic in the area and very recent anecdotal observations appear to support this hypothesis,

with landings even taking place on Saunton Sands. This kind of low flying and persistent air traffic can cause significant disturbance to birds.

5.4.66 Remarkably, (and possibly worryingly), just three events involving birds of prey were noted, with the most disturbance arising from a Buzzard flying from Braunton Marsh to Instow flushing 45 individuals of WeBS species.

5.4.67 Two large military training operations involving numerous vessels offshore and vehicles on the beach were observed between Zeta Birth and Instow slip way. No resulting disturbance was observed, although it would be fair to assume birds were excluded from the area.

Comparison with other studies

5.4.68 In order to gauge levels of disturbance at the TTE in relation to other areas, selected data was compared to other similar studies (Table 46).

5.4.69 Overall, the Taw Torridge appears to show a similar disturbance profile to other sites, although the rate of major flights per hour is higher than at all but one other site (Table 46). This may be due to bias in the site selection as this study sought to observe such events.

5.4.70 An obvious feature of the TTE that was confirmed by this study and that appears to be high in relation to other sites, is the high proportion of disturbance caused by dog walking.

Table 46. Comparison of selected data from this study with other similar studies conducted by Footprint Ecology, adapted from Ross & Liley (2014).

Site	Exe	Solent	N.Kent	Poole	Humber	Taw Torridge
Hours survey	220	420	449.75	294	140	146
Survey locations	9	20	22	15	10	6
Location selection	Distributed around shore	Stratified along shore	Stratified along shore	Stratified along shore	Distributed where access and birds coincide	Selected for geographical coverage of estuary and at areas where access and birds coincide
Diary events	2977	5405	1879	3584	1304	1535
Visitor rates (events per hour)	13.5	12.9	4.2	12.2	9.3	10.5
% events causing major flights	14	8	13	6	14	11
Major flights per hour of observation	1.09	0.81	0.91	0.74	2.50	2.18
% Major flights caused by dog walkers or their dogs	37	49	55	38	40	76

6 Conclusions

Bird populations and distribution

6.1.1 Wintering waterbird populations at the Taw Torridge estuary have been monitored in detail for >40 years and have declined significantly over this period.

6.1.2 The wintering bird assemblage is numerically dominated by Lapwing and Golden Plover. Lapwing populations have declined dramatically while Golden Plover numbers have been variable over the years but are not necessarily in decline.

6.1.3 The Ashford to Heanton, Penhill to Fremington and Chivenor sectors are of primary importance to wintering WeBS species at low tide. There is limited access to the intertidal zone at these locations for land-based recreational activity.

6.1.4 Other important areas at low tide include Crow Point to Airy Point, Skern, Fremington to Isley, Pottington to Ashford and Isley to Yelland. The River Torridge appears to have declined in importance at low tide.

6.1.5 At high tide, Heanton to Caen, Isley to Instow, River Caen and Horsey Island and Skern are of primary importance to wintering WeBS species. The Heanton to Caen sector is especially rich in birds and notable for its lack of official access for pedestrian traffic.

6.1.6 The most recent WeBS data suggests an increasing importance of the Horsey Island area, especially for Lapwing and Golden Plover, since the breach of the outer sea wall in 2017.

High tide roosts

6.1.7 A total of 21 high tide roosts were identified, mapped and described. The distribution of roosts is greatest in the lower reaches of the River Taw and around the estuary mouth. Most high tide roost sites are in areas of more limited access for recreational activity.

6.1.8 The high tide roost at Crow Point is considered most at risk of disturbance from recreational activity, specifically walkers and dog walkers, and the site's ability to host roosting birds during the daylight hours appears to have been compromised by visitor access.

6.1.9 All high tide roosts described are considered to have the potential to hold >5% of the estuary's population of at least one WeBS species. High tide roosts at Skern, Isley Marsh, Yelland, Instow, and Chivenor are particularly important.

6.1.10 All winter high tide roosts are considered potentially vulnerable to increasing recreational activity on the estuary. Increasing access of roost areas by walkers and especially dogs off the lead are considered the greatest risk to the ability of roost sites to host roosting birds.

Recreational activity and disturbance to birds

6.1.11 A range of recreational activity takes place on the Taw Torridge estuary throughout the winter period including walking and dog walking, angling and bait digging, various water sports and wildfowling. Increasing access and estuary use has been reported for most activities in recent years.

6.1.12 Walking and dog walking are identified as the most prevalent recreational activities on the estuary in winter by a significant margin, with other activities being comparatively rare. The entire estuary is used by walkers and dog walkers, with these showing a preference for the intertidal zone in the estuary mouth. On the Taw and Torridge rivers themselves, walkers are more restricted to the available paths.

6.1.13 Walking and dog walking is most prominent at Instow and surrounds, Westward Ho!, Saunton and the White House to Crow Point area that are characterised by sandy beaches. Walkers here do however also access areas of intertidal rock, shoreline and saltmarsh.

6.1.14 Walkers with dogs off the lead are identified as the overwhelmingly dominant cause of disturbance to wintering WeBS species on the estuary. Disturbance arising from other event categories is rare.

6.1.15 The numbers of birds of WeBS species at the six study sites declined with increasing access by recreational users.

6.1.16 The full range of regularly encountered WeBS species were observed exhibiting disturbance responses at the selected study sites. In terms of the numbers of individual birds disturbed, Golden Plover, Oystercatcher, Wigeon, and Brent Goose were most affected.

6.1.17 The number of disturbance responses at all sites increased with the number of recreational activity events. It is suggested that total exclusion can eventually occur. Events considered to clearly demonstrate exclusion of birds from suitable habitat were observed.

6.1.18 Flight based responses were most frequently observed, suggesting an energetic cost in addition to the loss of available feeding or resting time. Furthermore, a flight away from a preferred area introduces the possibility of relocation to a less optimal area.

6.1.19 Proximity to recreational activity influences the level of disturbance response, although the range at which disturbance can occur appears highly variable and possibly greater than suggested by many previous studies.

6.1.20 Roosting and foraging birds were observed being disturbed, throughout the tide, from all habitat types, in all weathers and at all times of day.

6.1.21 Very little non-recreational activity, such as by commercial aircraft was observed throughout the study, with little disturbance such factors as a result.

6.1.22 Any management and mitigation should focus on walkers with dogs off the lead as the primary instigator of disturbance to wintering birds on the Taw Torridge estuary. A range of approaches, implemented across the estuary, are likely to be necessary to demonstrably reduce disturbance to wintering birds.

7 Recommendations for management, mitigation and further work

7.1 Background and aims

7.1.1 The Taw Torridge estuary, despite boasting various designations and protected areas, is notably lacking in ongoing conservation-based management initiatives for the benefit of the wintering waterbird assemblage.

7.1.2 The estuary suffers from a general lack of site-based staffing and adequate protection of sensitive areas. Although there is some general interpretation and an estuary code of conduct on display at major access points for water users, there is very little targeted interpretation aimed at pedestrian based recreational users or the wintering bird assemblage.

7.1.3 Most crucially, there is a lack of any guidance or restriction on access or use of protected or sensitive areas.

7.1.4 The results reported here confirm that disturbance to roosting and foraging birds is routine at important locations across the estuary, and recreational activity reduces the numbers of birds able to utilise specific areas.

7.1.5 Development, particularly housing, will inevitably lead to greater recreational use of the estuary and increased pressure on a wintering bird population that has suffered proven and serious declines in recent years.

7.1.6 In light of the findings regarding the wintering bird assemblage and levels of disturbance arising from recreational activity, it is deemed essential to make provision for conservation-based management and mitigation.

7.1.7 Site-specific recommendations are provided in the high tide roost profiles in Section 3 of this report, where such specific management and mitigation approaches are thought to be appropriate. In some cases, very specific detail is provided on, for example, suggested locations for signage and interpretation.

7.1.8 This section of the report presents a basic overview of suggested potential approaches to reduce the disturbance levels experienced by wintering WeBS species throughout the tidal cycle.

First steps: Workshop event

7.1.9 As part of this project a workshop event was held to disseminate the initial findings and further engage estuary user groups, stakeholders, project partners and interested individuals.

7.1.10 The event was a resounding success, attended by 35 individuals representing all major estuary interests. The event hosted and stimulated an ongoing discourse on the issues of disturbance to wintering birds at the TTE, but also on related conservation and management issues throughout the year.

7.1.11 It is suggested that going forward, partnership working between estuary stakeholders will be essential to deliver effective management and mitigation that can increase biodiversity and achieve other conservation objectives on the TTE. A suitable umbrella organisation needs to be identified to co-ordinate and manage such a partnership.

7.2 Management and mitigation

Signage and interpretation

7.2.1 Signage and interpretation, if well placed and well designed, could be a cost-effective management tool with the potential to influence the behaviour of many estuary users.

7.2.2 The following recommendations may be borne in mind for any signage and interpretation planned for the estuary.

- Major signs are best located at access points such as car parks and the heads of footpaths. Attaching minor (small) signs to dog waste bins may also be effective.
- Alternatively, when located at specific sites, signs should be clearly visible when entering or passing sensitive areas.
- Signage should be clear and precise. Mapping of specific areas and relating advice to that area is more effective than broad guidelines. For example, the recommendation to keep dogs “under close control” is demonstrably ineffective.
- To increase the chance of compliance it is vital that clear reasoning and justification is provided on all signage requesting any modification of the behaviour or activity of recreational estuary users.
- Advice should be sought regarding the siting of signs. For any signage aiming to protect wintering birds on the TTE, the WeBS team should be consulted.

Publications and media representation

7.2.3 Specific published material, such as pamphlets targeting various estuary user groups could be designed, printed and distributed. Dog walking, identified as the major cause of bird disturbance on the estuary in this study, should be considered to be the recreational activity most worthy of focus.

7.2.4 Published material could contain the following information:

- Maps showing specific high tide roost locations and important feeding areas.
- Information on the wintering bird assemblage and its importance.
- Suggested walking routes (possibly for different tidal states).

- Code of conduct for reducing potential disturbance.

7.2.5 Such a pamphlet could be distributed through Ilfracombe Dog Trust, local veterinarians, other estuary user groups, local shops and services and conservation-based groups and organisations.

7.2.6 Publications targeting terrestrial and offshore users separately might also be considered and could be distributed through clubs and organisations. A pamphlet regarding recreational use of the estuary might even be provided as part of the package of information for home buyers at new developments in the vicinity of the estuary.

7.2.7 Information could also be distributed through social media and websites and a campaign highlighting the issue of disturbance to wintering birds, focused on estuary user behaviour modification could be delivered through local or even national media.

7.2.8 A project set up around the South Devon Natura 2000 sites with the aim of promoting ecologically responsible dog ownership called “Devon Loves Dogs” (https://www.devonlovesdogs.co.uk/, accessed 10/4/2019) may be able to facilitate the engagement of local dog walkers with management and mitigation proposals.

Protected areas and access arrangements

7.2.9 Ultimately the most effective means of reducing disturbance to wintering birds is through the protection and preservation of currently undisturbed areas such as the intertidal River Taw between Chivenor and Ashford, while simultaneously attempting to create new protected areas and discourage access to sensitive areas that are currently disturbed.

7.2.10 It may be possible to set out voluntary or enforced “nature zones” or similar, where it is suggested that access to intertidal areas is not made by people carrying out recreational activities. Considering the high levels of disturbance associated with dog walking and the fact that some dog walkers may not class themselves as recreational users, this activity should be explicitly stated as undesirable in these areas.

7.2.11 The establishment of “nature zones” can only be effective alongside other measures and on-site signage and interpretation would be essential. Ideally a high-profile media campaign, estuary user engagement, and publication of supporting information for dissemination to estuary users would also be undertaken.

7.2.12 With the prospect of on-site staff being employed in some areas of the estuary it may be possible to further discourage the use of such areas through face-to-face engagement.

7.2.13 The provision of further on-site staffing, allowing for increased engagement with recreational users of the estuary could yield great benefits not just for the protection of wintering birds, but also breeding birds, other wildlife and general

habitat quality. A wardening presence across the estuary, focused on the most sensitive areas, is suggested.

7.2.14 Additionally, new protected areas could be provided. The current status of Horsey Island, which is for sale, offers an opportunity for the development of an ideally located nature reserve in N. Devon with great potential. The site is challenging from an ongoing management perspective due to the highly dynamic situation and embryonic habitat. Further complications arise as the shooting rights are held by a third party and are not currently for sale. However, such issues and much greater have been overcome elsewhere to provide wintering birds with both the habitat, and the opportunity, to thrive.

7.3 Further work

7.3.1 The collection of specific high tide roost count data during wider WeBS sector counts should be introduced. A standard methodology and data recording sheet are required to ensure systematic and consistent data collection.

7.3.2 A complete low-tide WeBS count of the estuary should be undertaken every winter. If complete coverage is not possible, survey effort should be directed at the River Taw and estuary mouth sectors. A new sector should be defined to provide counts at Horsey Island.

7.3.3 To truly assess the impacts of disturbance on wintering birds the manipulation of disturbance factors is essential. The results presented here provide a baseline state for the TTE that any future management or mitigation could utilise to test for improvements.

7.3.4 The complete identification of locations bordering, or in the vicinity of, the TTE SSSI that are used by the wintering bird assemblage (especially Lapwing and Golden Plover) for feeding and roosting could facilitate the protection of these areas.

7.3.5 The identification of areas that may provide potential as future protected areas for wintering (and breeding) birds should be considered in light of rising sea levels and increasing recreational pressure on the estuary.

7.3.6 It is suggested that the project partners endeavour to forge an ongoing working relationship with the goal of achieving a balance between the need for development in the local area and improving the status of the estuary with respect to biodiversity and nature conservation objectives.

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Although WeBS data are presented within this article, in some cases the figures may not have been fully checked and validated. Therefore, for any detailed analyses of WeBS data, enquiries should be directed to the WeBS team at the British Trust for Ornithology, The Nunnery, Thetford, IP24 2PU (webs@bto.org).

9 References

Banks, P.B. & Bryant, J.V. (2007) Four-legged Friend or Foe? Dog-walking Displaces Native Birds from Natural Areas. *Biology Letters* 3: 611-613.

Berridge, R. (2017) *Bird Monitoring Activity for the Great Oakley Temporary Helipad Scheme*. Unpublished consultants report for Galloper Offshore Wind Farm Limited, 36pp.

Bright, A., Reynolds, G.R., Innes, J. & Waas, J.R. (2003) Effects of motorised boat passes on the time budgets of New Zealand dabchick, *Poliocephalus rufopectus*. Wildl. Res., 30, 237–244.

Burton, N.H.K., Armitage, M.J.S., Musgrove, A.J. & Rehfisch, M.M. (2002) Impacts of man-made landscape features on numbers of estuarine waterbirds at low tide. *Journal of Environmental Management* 30: 857–864.

Burton, N.H.K., Rehfisch, M.M. & Clark, N.A. (2002) Impacts of disturbance from construction work on the densities and feeding behavior of waterbirds using the intertidal mudflats of Cardiff Bay, UK. *Journal of Environmental Management* 30: 865–871.

Cook, A.S.C.P., Barimore, C., Holt, C.A., Read, W.J. & Austin, G.E. (2013). *Wetland Bird Survey Alerts 2009/2010: Changes in numbers of wintering waterbirds in the Constituent*

Countries of the United Kingdom, Special Protection Areas (SPAs) and Sites of Special Scientific Interest (SSSIs). BTO Research Report 641. BTO, Thetford.

Cryer, M., Linley, N.W., Ward, R.M., Stratford, J.O. & Randerson, P.F. (1987) Disturbance of overwintering wildfowl by anglers at two reservoir sites in South Wales. *Bird Study* 34: 191–199.

Davidson, N.C. & Rothwell, P.I. (1993) Disturbance to waterfowl on estuaries: the conservaton and coastal management implications of current knowledge. *Wader Study Group Bulletin* 68: 97-105

Drewitt, A. (1999) *Disturbance Effects of Aircraft on Birds*. English Nature, Peterborough.

European Parliament, Council of the European Union (2009). *Directive 2009/147/EC of the European Parliament and of the council of 30 November 2009 on the conservation of wild birds.* European Parliament, Council of the European Union.

Fitzpatrick, S. & Bouchez, B. (1998) Effects of recreational disturbance on the foraging behaviour of waders on a rocky beach. *Bird Study* 45: 157–171.

Fox, A.D. & Madsen, J. (1997) Behavioural and distributional effects of hunting disturbance on waterbirds in Europe: implications for refuge design. *Journal of Applied Ecology* 34: 1–13.

Goss-Custard, J.D., Triplet, P., Sueur, F. & West, A.D. (2006) Critical thresholds of disturbance by people and raptors in foraging wading birds. *Biological Conservation* 127: 88–97.

Gray, A.C. (2006) *Impacts of Human Disturbance on the Behavior of Sanderlings on the Georgia Coast*. Electronic Theses and Dissertations. 732.

https://digitalcommons.georgiasouthern.edu/etd/732

Kirby, J.S., Clee, C. & Seager, V. (1993) Impacts and extent of recreational disturbance to wader roosts on the Dee estuary: some preliminary results. *Wader Study Group Bulletin* 68: 53–58.

Krüger, T. (2018) On the effects of kitesurfing on waterbirds - a review. *Naturschutz Informationsdienst Niedersachsen* 36: 3-64.

Latham, J. (2015) *Identification of wintering waterbird high tide roosts on the Severn Estuary SSSI/SPA*. Unpublished consultant's report to Natural England.

Liley, D., Cruickshanks, K., Waldon, J. & Fearnley, H. (2011) Exe Disturbance Study. Footprint Ecology / Exe Estuary Management Partnership.

Nolet, B.A., Bevan, R.M., Klaassen, M., Langevoord, O. & Van der Heijden, Y. (2002) Habitat switching by Bewick's swans: maximization of average long-term energy gain? *Journal of Animal Ecology* 71: 979–993

Regel, J. & Putz, K. (1997) Effect of human disturbance on body temperature and energy expenditure in penguins. *Polar Biology* 18: 246–253

Ross, K. & Liley, D., (2014) *Humber Winter Bird Disturbance Study*. Unpublished report for the Humber Management Scheme by Footprint Ecology.

Rose, P.M. & Scott, D.A. (1997) *Waterfowl Population Estimates – Second Edition*. Wetlands International Publication No. 44, Wageningen, The Netherlands.

Robinson, J.A. & Pollitt, M.S. (2002) Sources and extent of human disturbance to waterbirds in the UK: an analysis of Wetland Bird Survey data, 1995/96 to 1998/99. *Bird Study* 49(3): 205-211. doi: 10.1080/00063650209461267

Thomas, K., Kvitek, R.G. & Bretz, C. (2003) Effects of human activity on the foraging behavior of sanderlings *Calidris alba*. *Biological Conservation* 109: 67–71.

Musgrove, A.J, Langston, R.H.W, Baker, H. & Ward, R.M. (2003) *Estuarine Waterbirds at Low Tide: The WeBS Low Tide Counts 1992/93 to 1998/99*. WSG/BTO/WWT/RSPB/JNCC, Thetford.

Natural England Taw Torridge Estuary SSSI citation (1998) (last accessed February 2019)

https://designatedsites.naturalengland.org.uk/PDFsForWeb/Citation/1002990.pdf

Pretty, J., Griffin, M., Peacock, J., Hine, R., Selens, M. & South, N. (2005) A countryside for health and well-being: the physical and mental health benefits of green exercise. *Countryside Recreation* 13,: 2–7.

Stillman, R.A. & Goss-Custard, J.D. (2002) Seasonal changes in the response of oystercatchers *Haematopus ostralegus* to human disturbance. *Journal of Avian Biology* 33: 358–365.

Stock, M. & Hofeditz, F. (1997) Compensatory limits: energy budgets of Brent Geese, *Branta bernicla*, the influence of human disturbance. Journal für Ornithologie 138: 387–411.

Thiel, D., Jenni-Eiermann, S., Palme, R. & Jenni, L. (2011) Winter tourism increases stress hormone levels in the Capercaillie *Tetrao urogallus*. Ibis 153: 122–133.

North Devon AONB and Biosphere Reserve Service (2015), Bideford Station, East the Water, Bideford https:// www.northdevonbiosphere.org.uk/uploads/1/5/4/4/15448192/_4-estuary_management_plan-action-plan.pdf

Walker, B.G., de Boersma, P. & Wingfield, J.C. (2006) Habituation of adult Magellanic penguins to human visitation as expressed through behaviour and corticosterone secretion. *Conservation Biology* 20: 146–154.

Yasué, M. (2005) The effects of human presence, flock size and prey density on shorebird foraging rates. *Journal of Ethology* 23: 199–204.

10 Appendix

10.1 Appendix 1: WeBS counter questionnaire

WeBS Count Area Name:						WeBS Count Area Code:		
High tide roost site location and spatial extent. <u>Please draw a representation of the roost on the relevant map.</u> Mark these roosts with an ID code on the map for cross reference to this form. Complete a form for each roost. Low tide roosts, foraging areas and anything else of interest (e.g. point sources of disturbance) can also be marked on map with explanatory notation.								
Roost ID code (RID 'x')	RID		Roost location (OS grid reference if possible)					
Estimated roost area		m^2	Roost viewing location for WeBS count, please mark on the map (VID 'x').			VID	Notes	
High tide roost species composition and abundance as observed during WeBS core counts. Give trends if known, alter column headers if you want to give a lesser or greater time scale. Site fidelity is the proportion of WeBS visits the roost is present (low=0-30%, medium=30-65%, high=65-100%). For site use/behaviour give an approximation of % time all birds of that species are engaged in each behaviour if possible.								
Species	Approximate WeBS count within roost (previous 5 years)			Trend (+/-) Give % if possible		Fidelity	Typical behaviours	Pattern of use	Notes
	Min	Max	Typical count	5 years	10 years	L/M/H	e.g. feed x%, rest x%	e.g. particular weather, tide?	
…….									
Roost site habitat and substrate composition. A rough idea of the ground cover of the roost area drawn on map, give an approximate % cover.								
Substrate cover	%	General description of roost site area, associations with features and/or habitat or any notes of interest.						
Mud								
Sand								
Shingle								
Saltmarsh								
Rock								
Man-made structure								
Water								

Roost site disturbance sources, frequency, location, severity, effects. Most will affect all species but identify any species-specific impacts if present. An idea of any assumed 'zone' of impact would be useful, e.g. no waders within 100m of Tarka Trail.				
Species	Source of disturbance	Description of disturbance	Frequency and duration	Effects on roost
…..				
Supplementary information				
Is there a specific route to best access the roost viewing location? Are there any access issues, or constraints on viewing any part of the sector?				
Has disturbance with the potential to affect this roost increased in recent years? What kind of disturbances? What are the biggest perceived threats to the roost?				
Does the roost tend to relocate to another area of the estuary if disturbed, or under certain conditions?				
Could any reasonable measures be taken to reduce disturbance at this roost site?				
Any further notes, suggestions, descriptions of other features marked on the map, etc.				

10.2 Appendix 2: Estuary user survey questionnaire

Question	Response choices
What activities do you undertake at/on the estuary? (tick all that apply)	Walking, dog walking, jogging, horse riding, gig rowing, bird and nature watching, wind or kite surfing, kayak/canoe/ski paddle/S.U.P., metal detecting, cycling, sailing, powerboating, angling and bait digging, other (please specify)
Where do you visit most frequently? (tick all that apply)	Instow, Westward Ho!, Saunton, Skern, Braunton Burrows, Yelland area, Fremington area, Chivenor area, Barnstaple area, Appledore area, Taw – upstream of new bridge, Torridge – upstream of new bridge, Other (please specify)
How far do you usually travel to access the estuary?	<1 mile, 1-5 miles, 5-10 miles, 10-20 miles, >20 miles
How long do you typically spend at the estuary?	<30 minutes, 30 minutes – 1hour, 1- 4 hours, 4 – 6 hours, all day,
How frequently do you visit the estuary?	Daily, more than 3 days a week, 2-3 days a week, once a fortnight, once a month, weekends only, several times a year, rarely
Why do you visit/use the estuary?	Location, open space, scenery, wildlife
Are you aware the estuary is a site of special scientific interest and of particular importance to wintering birds?	Yes / no
Do you believe there should be any management of human recreational activity on the estuary to benefit wildlife?	Yes / no / yes in principle, but not if it restricts my use of the estuary

10.3 Appendix 3: List of vernacular names, full names and scientific names of all birds referred to in this report

British (English) vernacular name	IOC World Bird List international English name	Scientific name
Brent Goose	Brant Goose	*Branta bernicla*
Pink-footed Goose		*Anser brachyrhynchus*
Shelduck	Common Shelduck	*Tadorna tadorna*
Wigeon	Eurasian Wigeon	*Mareca penelope*
Mallard		*Anas platyrhynchos*
Pintail	Northern Pintail	*Anas acuta*
Teal	Eurasian Teal	*Anas crecca*
Scaup	Greater Scaup	*Aythya marila*
Eider	Common Eider	*Somateria mollissima*
Goldeneye	Common Goldeneye	*Bucephala clangula*
Goosander	Common Merganser	*Mergus merganser*
Red-breasted Merganser		*Mergus serrator*
Great Northern Diver	Common Loon	*Gavia immer*
Little Grebe		*Tachybaptus ruficollis*
Great Crested Grebe		*Podiceps cristatus*
Black-necked Grebe		*Podiceps nigricollis*
Spoonbill	Eurasian Spoonbill	*Platalea leucorodia*
Cattle Egret	Western Cattle Egret	*Bubulcus ibis*
Grey Heron		*Ardea cinerea*
Little Egret		*Egretta garzetta*
Shag	European Shag	*Phalacrocorax aristotelis*
Cormorant	Great Cormorant	*Phalacrocorax carbo*
Osprey	Western Osprey	*Pandion haliaetus*
Marsh Harrier	Western Marsh Harrier	*Circus aeruginosus*
Buzzard	Common Buzzard	*Buteo buteo*
Oystercatcher	Eurasian Oystercatcher	*Haematopus ostralegus*
Avocet	Pied Avocet	*Recurvirostra avosetta*
Lapwing	Northern Lapwing	*Vanellus vanellus*
Golden Plover	European Golden Plover	*Pluvialis apricaria*
Grey Plover		*Pluvialis squatarola*
Ringed Plover	Common Ringed Plover	*Charadrius hiaticula*
Curlew	Eurasian Curlew	*Numenius arquata*
Bar-tailed Godwit		*Limosa lapponica*
Black-tailed Godwit		*Limosa limosa*
Turnstone	Ruddy Turnstone	*Arenaria interpres*
Knot	Red Knot	*Calidris canutus*
Ruff		*Calidris pugnax*
Sanderling		*Calidris alba*
Dunlin		*Calidris alpina*
Snipe	Common Snipe	*Gallinago gallinago*

British (English) vernacular name	IOC World Bird List international English name	Scientific name
Common Sandpiper		*Actitis hypoleucos*
Redshank	Common Redshank	*Tringa totanus*
Spotted Redshank		*Tringa erythropus*
Greenshank	Common Greenshank	*Tringa nebularia*
Black-headed Gull		*Chroicocephalus ridibundus*
Common Gull	Mew Gull	*Larus canus*
Great Black-backed Gull		*Larus marinus*
Herring Gull	European Herring Gull	*Larus argentatus*
Peregrine	Peregrine Falcon	*Falco peregrinus*