

Comparison of the abundance and distribution of birds along the northern shore of Poole Harbour by day and by night

First published 15 September 2009

www.naturalengland.org.uk



Summary

The northern shore of Poole Harbour has been heavily developed and is urban in character, supporting a high human population. As such the area is under considerable human pressure. An analysis of WeBS counts data between 1991 and 1998 revealed that counts of birds along many sectors of this shoreline are lower than might be expected on the basis of the available feeding area of intertidal habitat. However, such counts are conducted during the day time, when disturbance may cause birds to avoid the shoreline. This work was therefore commissioned by Natural England in order to enhance the understanding of the importance and use of the northern shore of Poole Harbour.

We explore the distribution and abundance of various bird species along the northern shoreline of Poole Harbour during the night time and the day time.

The key findings of this survey were as follows:

- A total of 31 bird species were recorded, 25 of which occurred both during the day and night.
- Overall, there were significantly more waders, waterfowl and gulls present during daylight than at night.
- The only group of birds largely absent at night were gulls, which tended to roost off-shore at night.
- Three areas were more heavily used (total number of birds recorded) at night than during the day: Blue Lagoon, Baiter foreshore and the area of beach / marsh / reeds at the top of Whitley Lake.
- Waders tended to be present at reduced densities at night, with the exception of dunlin, grey plover and ringed plover which were more abundant at night.
- There were three nights when the number of waders (total count data) was higher in the night than during the preceding day.
- Dunlin were notable, with reasonably large flocks present during the night at Parkstone Bay and within Whitley Lake, both areas in which they were not recorded during the day.
- Ringed plovers were recorded during the day, but virtually always in roosting flocks, and in very few locations. At night they were more widely distributed, feeding in small groups / pairs.
- Two species, jack snipe and snipe were recorded only at night.
- Holes Bay and Blue Lagoon held the highest numbers of birds during the day and at night. In general, areas along the northern shore that held more birds during the day than others were also relatively well used at night.
- Recreational use of the shore by people included a range of activities, such as canoeing, kite surfing, para-sailing, windsurfing, dog-walking, fishing and bait digging. The distribution of each of these activities varied and different activities occurred at different times.
- The numbers of people peaked at weekends and was significantly greater during daylight than at night. There was, however, considerable human activity at night.
- There was some evidence that areas that are heavily used by people during the day are also relatively heavily used at night.
- Evidence of a negative association between bird usage and human activity levels on the northern shore of the harbour is mixed.

The key conclusions of this study are as follows:

- Daytime bird surveys of the north shore will underestimate usage of those areas by jack snipe, snipe, dunlin, ringed plover and grey plover.
- Assessment of the relative importance of the various parts of the north shore in terms of bird usage as assessed during daylight is, however, unlikely to significantly misrepresent their relative importance at night.
- However, daytime bird surveys risk underestimating the overall usage of Blue Lagoon, Baiter foreshore and the area of beach at the top of Whitley Lake.
- Surveys aimed at estimating the importance of parts of the northern shore in terms of bird usage should be timed to avoid periods of intensive human activity.

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3 Results

Summary of site visits

- 3.1 Fifteen paired visits (that is, fifteen daytime and fifteen night time visits) were made between 7th November 2007 and 8th February 2008. Details of these visits (tide heights, times etc.) are summarised in Appendix 3. Five of these pairs took place at weekends. Five of the night time visits took place in the early evening (that is, before 9pm), three started between 9pm and midnight and the remaining seven night visits were started after midnight.

Bird species recorded

- 3.2 A total of 31 species were recorded. Virtually all species were recorded both during the day and during the night. Two species (jack snipe *Lymnocyptes minimus* and snipe *Gallinago gallinago*) were only recorded in the night and not during the day, both of these were rarely recorded. The only species recorded during the day, and not during the night, were gulls: Mediterranean gull, common gull *Larus canus*, lesser black-backed gull *Larus fuscus* and yellow-legged gull *Larus michahellis*.
- 3.3 The species recorded, by species group and location, are shown in Table 2a-d. The tables combine the point counts and total counts and simply highlight which species were present at night and during the day in each area. For Blue Lagoon it can be seen that more wader species were recorded during the day than during the night. For Parkstone Bay, Whitley Lake, Hamworthy and Holes Bay more wader species were recorded at night. The species that seem most often absent from these areas during the day, but present at night were dunlin *Calidris alpina*, ringed plover and grey plover *Pluvialis squatarola*. Dunlin and ringed plover were particularly marked in their presence at night. Ringed plovers were rarely recorded during any of the day visits, the few day records were mostly of a flock of up to 38 birds roosting in Blue Lagoon. At night the species was widespread, in small numbers. Dunlin were not recorded during the day at all in Parkstone Bay, Holes Bay or Whitley Lake. Flocks were occasionally recorded in these areas at night. Grey plover were never common, but were recorded at night in a few locations where they were not seen during the day, including the shoreline at Hamworthy Park and along the shoreline at Whitecliff / Baiter, within Parkstone Bay.
- 3.4 All wildfowl species were recorded both during the day and the night. Wigeon *Anas penelope*, pintail and teal *Anas crecca* were largely restricted to Holes Bay, where they were present on virtually all visits, night and day. Locations that held birds during the day also appeared to hold birds during the night.
- 3.5 Gulls were largely absent at night and widespread during the day. Gulls were regularly heard calling offshore at night, presumably from birds roosting on the water. On a number of occasions gulls were picked out roosting on the water or circling low over the water well off-shore from Ham Park, with 1000s of birds clearly using this area to roost. On the night of the 1st February, at c.02.30, gulls were recorded leaving this roost and 100s were counted flying low over Ham Park (count areas 1 and 2) and heading due north. None landed within the count area. Holes Bay occasionally held roosting gulls, on one night 6500 black-headed gulls *Larus ridibundus* were estimated to be roosting here, and it was in Holes Bay that the only night time records for herring gull *Larus argentatus* and great black-backed gull *Larus marinus* occurred (both roosting). The roosting gulls were often very distant (400m plus) and therefore counts were very approximate. At such distances some of the rarer species would have been missed.

Table 2a Species recorded in different areas, during the night and day - Waders

Species	Hamworthy		Holes Bay		Parkstone Bay		Blue Lagoon		Whitley Lake		All Sites	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Oystercatcher	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	5	5
Curlew	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	4	5
Redshank	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	4	5
Dunlin	✗	✗	✗	✓	✗	✓	✓	✓	✗	✓	1	4
Grey plover	✗	✓	✗	✗	✓	✓	✓	✓	✗	✓	2	4
Black-tailed Godwit	✗	✗	✓	✓	✗	✗	✗	✗	✓	✗	2	1
Bar-tailed Godwit	✗	✗	✓	✓	✓	✗	✓	✗	✓	✓	4	2
Avocet	✗	✗	✓	✓	✓	✗	✓	✗	✗	✗	3	1
Ringed plover	✓	✓	✓	✗	✗	✓	✓	✓	✗	✓	3	4
Greenshank <i>Tringa nebularia</i>	✓	✓	✓	✗	✗	✓	✓	✗	✓	✓	4	3
Spotted redshank ¹ <i>Tringa erythropus</i>	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	1	1
Turnstone	✓	✗	✗	✗	✓	✓	✓	(✓)	✓	✗	4	2
Jack Snipe	✗	✗	✗	✓	✗	✗	✗	✗	✗	✗	0	1
Snipe	✗	✗	✗	(✓)	✗	(✓)	✗	✗	✗	✗	0	2
Knot	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	1	1
Total Species	4	6	9	10	7	10	10	7	8	9	13	15

Ticks indicate that the species was present on at least one occasion in the given area. Birds only heard at night are included, in such cases the ticks are in parenthesis.

¹ During the pilot study a spotted redshank was recorded in Parkstone Bay, but not during the main study

Table 2b Species recorded in different areas, during the night and day - Wildfowl

Species	Hamworthy		Holes Bay		Parkstone Bay		Blue Lagoon		Whitley Lake		All Sites	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Mute swan	✓	✓	✓	✓	✗	✓	✓	✗	✗	✗	3	3
Brent goose	✓	✓	✗	✗	✓	✓	✓	✓	✓	✓	4	4
Wigeon	✗	✗	✓	✓	✓	✗	✗	✗	✗	✗	2	1
Shelduck	✗	✗	✓	✓	✓	✗	✓	✓	✓	✗	4	2
Mallard <i>Anas platyrhynchos</i>	✗	✗	✓	✓	✓	✓	✓	✓	✗	✓	3	4
Teal	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	1	1
Pintail	✗	✗	✓	✓	✗	✗	✗	✗	✗	✗	1	1
Total Species	2	2	6	6	4	3	4	3	2	2	7	7

Table 2c Species recorded in different areas, during the night and day - Gulls

Species	Hamworthy		Holes Bay		Parkstone Bay		Blue Lagoon		Whitley Lake		All Sites	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Black-h Gull	✓	✗	✓	✓	✓	✓	✓	✗	✓	✓	5	2
Common Gull	✓	✗	✓	✗	✓	✗	✓	✗	✓	✗	5	0
Herring Gull	✓	✗	✓	✓	✓	✗	✓	✗	✓	✗	5	1
Lesser Bb Gull	✗	✗	✓	✗	✓	✗	✗	✗	✗	✗	2	0
Great Bb Gull	✗	✗	✓	✓	✓	✗	✓	✗	✓	✗	4	1
Mediterranean Gull	✗	✗	✗	✗	✓	✗	✓	✗	✓	✗	3	0
Yellow-legged gull	✓	✗	✓	✗	✗	✗	✗	✗	✓	✗	3	0
Total Species	4	0	6	3	6	1	5	0	6	1	7	3

Table 2d Species recorded in different areas, during the night and day - Herons

Species	Hamworthy		Holes Bay		Parkstone Bay		Blue Lagoon		Whitley Lake		All Sites	
	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night	Day	Night
Grey Heron <i>Ardea cinerea</i>	x	✓	✓	✓	x	✓	x	x	x	✓	1	4
Little egret	✓	x	✓	✓	✓	x	✓	x	✓	x	5	1
Total Species	1	1	2	2	1	1	1	0	1	1	2	2

Detectability at night

- 3.6 The ability to detect birds at night varied between different points. The amount of ambient light and the amount of lighting on the opposite shore / line of site influenced the effectiveness of the night vision equipment. When the mud was wet and there were lights opposite the mud often reflected light and this sometimes dazzled the observer. Some species were much more obvious than others, and were easy to pick out, even at large distances. Species such as mute swan *Cygnus olor* could be easily counted at considerable distances, and were clearly visible with the night vision equipment at 400m. Species such as avocet and shelduck stood out well. Avocet were also easy to detect as the night records tended to involve tight flocks feeding vigorously in shallow water.
- 3.7 In general we struggled to differentiate species at distances beyond 200m. This was particularly the case for mixed feeding flocks of waders on open mud. Curlew *Numenius arquata* and dunlin could usually be differentiated by size, but redshank, godwits, oystercatcher and grey plover were difficult to differentiate. When oystercatchers were reasonably close (somewhere between 100 and 200m depending on the light levels) it was possible to see the black and white body pattern.
- 3.8 At distances up to c.100m the infra-red illumination would pick out eye-shine, and this gave added confidence of picking out birds. Ringed plover feeding on the upper shore or amongst sea weed and rocks were typically picked up in this way.
- 3.9 Figures 4, 5, 6 and 7 give the densities of individuals at different distance bands, across all point counts, for selected species. Distance bands are pooled to 50m intervals, and the frequency distributions for the species are compared between night and day.
- 3.10 For some species (such as dunlin, ringed plover, oystercatcher, Brent goose and shelduck) there are declines in density above 200m during the day. It is unlikely that these species would be missed at such distances during daylight, and therefore the distribution is likely to be linked to habitat, tide or disturbance (for example, birds avoiding boats further out).
- 3.11 The distributions, at night, for redshank, ringed plover, Brent goose and dunlin all show peaks that are closer to the shore than during the day, suggesting these species are either missed at greater distances at night or that they tend to feed closer to the shore at night. For dunlin there is a marked decrease in recorded densities beyond 200m, oystercatcher and avocet both peak at 250, redshank at 150m and ringed plover at 100m. These data would suggest that at distances beyond 200m birds may be being under recorded.
- 3.12 There is also a general pattern of higher counts during the day, or relatively little difference between the day and the night. Dunlin is the clear exception, with many more counted at night than during the day. There is some variation in the shapes of the distributions for the different species. Oystercatchers show the highest day time densities close to the shore and decline with distance from the shore, whereas curlew tend to show increased densities with distance, indicating that the highest densities of this species were recorded away from the shoreline. Brent goose and shelduck show a peak in the middle distance bands.

4 Discussion

Overview of results

- 4.1 Six key questions were posed in the introduction, these have been addressed within the analysis and the results are summarised here:

Does the overall number (and density) of birds on the northern shore vary between night and day?

Yes. (See Figure 8, Figure 9a, Figure 9b, Figure 10, Table 3 & Table 5.)

A total of 31 bird species were recorded, 25 of which were present both during the day and the night. Overall there were significantly more waterfowl, waders and gulls present during daylight than at night. Gulls were largely absent at night. Waders were the main group recorded at night. There were three wader species which were significantly more abundant at night than during the day, these were dunlin, ringed plover and grey plover. Two further species, jack snipe and snipe, were only rarely recorded, but all records were at night.

Does the distribution of birds differ between the night and day?

Yes, to some extent. There were differences for some species and some locations. (See Figure 21, Figure 22, Figure 23 and Figure 24.)

Holes Bay and Blue Lagoon held the highest numbers of birds during the day and at night. In general the areas that held the highest densities during the day also held the highest densities at night (Figure 21 and Figure 23). Dunlin were notable, with reasonably large flocks present during the night at Parkstone Bay and within Whitley Lake, both areas in which they were not recorded during the day. Ringed plovers were recorded during the day, but virtually always in roosting flocks, and in very few locations. At night they were more widely distributed, feeding in small groups / pairs. Grey plover, ringed plover and snipe were all recorded on the open grass at Baiter during the night, oystercatcher was the only wader recorded here during the day.

Does the overall level of human disturbance on the northern shore differ between night and day?

Yes. (See Table 6 and Figure 16.)

Recreational use of the shore by people included a range of activities, such as canoeing, kite surfing, para-sailing, windsurfing, dog-walking, fishing and bait digging. The distribution of each of these activities varied and different activities occurred at different times. There were significantly more people during the day than at night (for example, Figure 16). People were still recorded at night, especially prior to 9pm. Canoeists, dog walkers, cyclists, bait diggers and fishermen were all recorded at night. All had artificial light with them.

Does the intensity of human disturbance differ between different parts of the northern shore?

Yes. (See Figure 18 and Figure 19.)

There were clear differences between different parts of the shore. The highest counts of people were from the shoreline parks at Hamworthy and Baiter / Whitecliff.

Can the difference in the distribution of birds between different parts of the northern shore between day and night be related to the difference in the distribution of disturbance between these same areas?

Partly. (See Figure 25 and Figure 27.)

In general the areas (such as Holes Bay and Blue Lagoon) that held the highest densities of birds during the day and the night were the least disturbed. Taking individual simultaneous counts of people and birds there was no significant effect of people on the density of birds.

Does the distribution of human disturbance in different parts of the northern shore of Poole Harbour differ between the night and the day?

Yes. (See Figure 20.)

The total count data, which gives the most complete counts of people shows that the areas that were busiest at night were also busiest during the day, but with less people present during the night than the day.

Ecological context

- 4.2 Most waders feed at night and there are many studies documenting nocturnal foraging in different species (for example, Burger et al., 1991; Burton et al., 2005; McNeil, Drapeau & Goss-Custard, 1992; Sitters, 2000; Stains & Burger, 1994; Whittingham, Percival & Brown, 2000). Detailed studies using radio-tracking have shown that oystercatchers, feeding in estuarine environments will feed on the same mussel *Mytilus edulis* beds during the day and during the night and that time budgets at night and during the day can be similar (Sitters, 2000). It is therefore perhaps not surprising that we have recorded so many species feeding at night along the northern shore.
- 4.3 The particularly interesting element of this work is the pressures that exist along the northern shore. Densities of waders in most of the WeBS count sectors on the northern shore of the harbour during the day are lower than would be expected given the area of intertidal mud that lies within them (Caldow et al 2005). The opposite is the case for most of the count sectors on the southern shore of the harbour. It would be interesting to determine whether the additional use of the northern shore at night compensates for the reduced use in day time - that is, is the level of use over the day and night combined similar to the levels of use in other areas of the harbour. To ascertain this further studies would be necessary to determine the use of the southern shore at night.
- 4.4 The areas of the northern shore that hold the most birds, both during the day and at night, are Holes Bay and Blue Lagoon. These are sheltered bays with large areas of soft sediment. These areas also happen to be the areas with the least disturbance. There is no path or public access to Blue Lagoon, but the bay is surrounded by housing and flats, most of which have access to the shoreline. People, including bait diggers were occasionally present within the lagoon. At Holes Bay the dual-carriageway and lack of close housing is probably the reason that few people were counted. There is a shoreline path, but levels of use here were much lower than at Parkstone Bay or Hamworthy. The only opportunities for people to park and access the shore here, without crossing the dual carriageway, are at Upton Country Park or near the mouth of the bay.
- 4.5 A range of factors besides simply disturbance are likely to determine choice of foraging location. Habitat quality and prey availability are clearly likely to be important (Caldow et al., 2005), yet were beyond the scope of this study. The fact that the lowest levels of disturbance coincide with large, extensive mudflats, holding soft mud (good foraging habitat) potentially confounds the apparent relationship shown in Figure 25 and Figure 27. Other factors such as distance to vegetation cover are also important to foraging waders (Yasue, 2006). It is therefore perhaps not surprising that the general linear models in Sections 3.31 and 3.34 explained a relatively small proportion of the variance in the data.

- 4.6 At each point / count area the relative proportion of different types of human activity were markedly different. For example, dog walkers favoured the grassy areas at Whitecliff and Ham Park, canoeists were most frequently recorded at Rockley and within Whitley Lake there were a wide range of water-sports. This study was not designed to determine the relative disturbance impacts of different activities. However, it does highlight the range of different activities that do take place and the varied pressures along the northern shoreline.
- 4.7 The range of species recorded at night is impressive, and many species were recorded in areas during the night where they were not present during the day. This was particularly apparent with dunlin, which were recorded at higher densities and in different locations at night. This has been shown at other locations, for example in the Wadden Sea, migrating dunlin tended to utilize different habitats during daytime and night-time, with relatively more birds aggregating on soft sediment containing high densities of *Corophium volutator* at night (Mouritsen, 1994). The same authors also found that anti-predator strategies were different at night, with the dunlin being quieter and flying less during darkness (Mouritsen, 1992).
- 4.8 It is well known that fox densities are higher in urban areas, and particularly where house densities are relatively low (Harris & Rayner, 1986). Foxes were frequently recorded at night, often well out on the mudflats, and the shoreline and mudflats were clearly used for feeding. On a number of occasions foxes were seen underneath or around jetties. Such structures may provide foraging opportunities, for example, crabs etc. or trapped debris, but it is also interesting to speculate the extent to which such structures may provide opportunities for foxes to hunt birds. It is only where there is the potential for foxes to hide or approach feeding birds unobserved that they are likely to pose a predation risk.

Accuracy of results and suitability of approach

- 4.9 The aim of this work was to determine the extent to which the northern shore is used by birds at night in comparison with daytime usage and the extent to which use varies between locations and species and is influenced by levels of human activity. Given the range of habitats and locations we felt it important to use different methods and therefore chose two different approaches. The advantage of the point counts is that they allow the observer to be stationary, to gain familiarity with specific locations and the use of distance sampling allows detectability to be incorporated in the analysis. The method is most suitable for areas of open habitat. The total count approach is only suitable for areas where it is possible to be confident that all birds within an area have been accurately counted, and is not appropriate for large expanses of open mud where declining detectability with increasing distance will be an issue at night. The total counts did provide a better overview of disturbance data and human use, allowing us to count people over a wide area.
- 4.10 One of the key difficulties was the tide and ensuring that day / night visits were paired. Tide heights on subsequent tides often varied. Poole Harbour is very shallow, and the tides are complex. Atmospheric pressure and wind speed often influenced the actual height of the tide on a given date, and small differences in tide height can lead to large differences in the amount of mud visible at particular locations, especially in Holes Bay, Blue Lagoon and Whitley Lake, where the gradient of the shore is very shallow. This problem resulted in some paired visits to certain locations being discarded from the dataset due to dissimilarity in tidal conditions.
- 4.11 Identification of birds at night was not always easy. The smaller waders, godwits and gulls were particularly difficult. Fortunately few gulls were present at night, but in the absence of any vocalisations we did not record Mediterranean gull and yellow-legged gull in darkness. At some locations where there were large expanses of open mud at low tide, such as Whitley Lake, Holes Bay and Blue Lagoon, night time recording was difficult. The night vision equipment would pick out birds far from the shore, but it would be impossible to identify them to species. Calls were often heard for species we had not recorded during the point counts. Our estimates of density and the total counts should therefore all be viewed in this context, they are likely to be under estimates of the number of birds present and it is likely that birds were missed at night. The