Population and distribution of wintering Woodcock in Poole Harbour

Winter 2013/14

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Summary

For some time, Mark Constantine has pondered over the potential wintering population of Woodcock in Poole Harbour.
Historically, winter records of woodcock in the harbour have either come from chance encounters or displaced birds during extended periods of freezing weather. More recent records have come from dusk watches at the edges of conifer plantations with up to 3 or 4 birds usually seen.
With a UK average wintering population estimated between 800,000 and 1 million birds and probably up to 1.4 million in a good year, Mark posed the question, were woodcock being under-recorded in Poole Harbour?

The resulting commissioned survey proved his suspicions correct, estimating the Poole Harbour wintering woodcock population to be nearly 650 birds.

Areas with the highest densities were fields west of Stoborough Heath and pasture south of Middlebere Heath, which together with fields at Hartland Stud, formed a core area. Other important areas were The Moors and Middlebere, with localised high densities also occurring at Ower and the Frome Valley.

Extensive counts in a range of habitat types revealed wet grazed permanent pasture to be the most important feeding habitat, with an average density of 76 birds per square km recorded.
Coastal and floodplain grazing marsh found at a few sites around the harbour recorded a very similar density of 75 birds per square km. Least popular of habitats that contained birds were ungrazed 'dry' permanent pasture with just 8 birds per square km recorded.

Although data on UK wintering woodcock densities is scant, figures obtained during this survey are the highest recorded, suggesting that Poole Harbour is an important site for wintering woodcock.

1. Introduction

1.1 Origins of wintering Woodcock

It has been known for some time that large numbers of woodcock arrive from the continent to spend the winter in the UK. Studies have estimated that 90% of the total British winter population comprise continental birds. (Hirons & Linsley 1989)

The origins of these birds have become more precise in recent years. Ringing records first indicated that most British and Irish birds originated from Russia and Fennoscandia. More recently, stable isotope analysis and satellite tagging have provided further insights into relationships between breeding and wintering areas.

British breeding woodcock are typically sedentary with only a very small proportion of birds making significant movements during the autumn. Most of these have been recovered in France or Spain with only one bird recovered in Dorset. Even during times of very cold weather, British birds are known to stay in their natal area. With no breeding birds, all of Poole Harbour's woodcock are presumed to be of continental origin. Indeed, we can be more precise than this. A recent survey by the Game and Wildlife Conservation Trust analysed over 1100 feathers from woodcock shot during December and January in six wintering areas scattered across the UK with some interesting results.
Although there was some mixing, there was an indication that particular breeding regions were associated with particular wintering areas, with southern England receiving the highest proportion of birds from southern Sweden and the Baltic States.

Woodcock are also known to be very faithful to their chosen wintering sites, using the same site and even the same fields year on year. Wintering site fidelity between successive winters may be as high as 80% (Hoodless 1994)

1.2 Foraging and roosting behaviour

Woodcock are curious birds for many reasons. One of their peculiarities being that they are diurnal during the breeding season and nocturnal during the winter, roosting by day undercover and flying out to feed in fields at night. This strategy is beneficial in terms of predator avoidance and feeding efficiency.

During the winter, the woodcock’s main prey item is the earthworm. These occur in highest densities in soft grazed fields, up to 12 times higher than in woodland (Duriez 2004). Feeding in open fields by day, however, would make woodcock vulnerable to predation; being essentially a cryptic bird they rely on camouflage which works well in woodland habitat but not quite so well in uniformly green fields.
In addition earthworms exhibit vertical migration at night, rising closer to the soil surface, making them more available.

Flying greatly increases the woodcock's probability of detection so, to minimise the time and conspicuousness of their movements, they prefer roost sites close to their feeding areas, ideally with an obstacle-free route, enabling them to fly at their preferred height just above the ground. Studies in Cornwall from radio-tagged birds recorded mean distances of these commuting flights between 322 and 444 m (Hoodless 1994, Hirons & Bickford-Smith 1983).
Studies in Spain showed that some birds even chose roost sites within walking distance of the feeding area. (Braña *et al* 2010)
As a result, winter home ranges are small, sometimes as little as 7ha and most commonly under 30 ha (Hirons and Bickford-Smith 1983, Hoodless 1994)

Diurnal roost sites are preferably dry, warm and free from disturbance, not only from humans but also creatures such as noisy pheasants! Plantations with rides are known to be popular but any suitably dry and quiet area of cover can be used.

Their only other requirement is frost-free fields. Being essentially a probing bird, woodcock cannot feed in permanent pasture at temperatures on or below freezing.

Given the mild climate and the amounts of grazed permanent pasture with adjacent plantations, hopes were high that Poole Harbour harboured high numbers of woodcock.

2. Objectives

The main purpose of the survey was to estimate Poole Harbour's wintering Woodcock population, to record distribution and where possible to gain insights into this rather enigmatic bird

3. Determining methods

Woodcock are particularly secretive and notoriously difficult to census, both as a breeding bird and a winter visitor. Although the UK population sizes of the majority of waders wintering in Britain are well known, there are no detailed estimates for woodcock.

A search for a methodological precedent revealed three UK surveys to have attempted woodcock population density estimates: The first, (Hirons & Linsley 1989) was used to estimate the UK wintering population. Hoodless, A.N. *Aspects of the ecology of the European woodcock Scolopax rustlcola* (1994) and Summers, R.W. & Buckland, S.T. *Numbers of wintering Woodcock Scolopax rustlcola in woodlands in the Highlands of Scotland* (1996) being the other two. Between them however, four different counting methods were used.
Two of the methods involved attending shoots, the other methods were nocturnal spot-lamp counting of feeding birds and diurnal transects with distance sampling to count roosting birds.

In (Hirons & Linsley and Hoodless 1994) winter density studies were predominantly carried out in the pasture-dominated areas of Cornwall. Their chosen method was nocturnal spot-lamping in conjunction with the attendance of shoots. In (Summers & Buckland 1996) the habitat was the predominantly pine forest areas of the Highlands and diurnal transects with distance sampling was used.
Spot-lamping suited Cornwall with its predominance of dairy pasture, and transects suited the Scottish pine forests. However Poole Harbour contains, relatively speaking, significant areas of both so, after ruling out the attendance of shoots, it wasn't entirely clear which method should be used.

The basic principle of spot-lamp counting is to scan fields and other likely feeding areas, noting the number of woodcock seen. Each field or feeding area is given a habitat classification and an average density for that type of habitat is then calculated.

Distance sampling involves walking pre-determined transects through a habitat, recording birds flushed, along with the angle of flight and distance to the transect line. Detection curves and distance probability models are then employed to calculate the densities. Each type of habitat requires a minimum number of registrations, as flushing distances may vary between habitats.

As well as stands of conifer forest, Poole Harbour also contains a wide variety of other habitat types that woodcock are known to roost in, such as deciduous woodland, coppice, hedgerow, gorse, holly, rhododendron, heather, bracken and bramble.
Given the potential amount of transect data needed for each habitat type, it seemed likely that spot-lamp counting was going to provide the most workable method to determine a population density. Footprint Ecology was consulted and it was agreed that both methods should be piloted and the results reviewed.

Before this survey began, the majority of Poole Harbour's woodcock records were from observations of commuting birds at plantation edges at dusk. This was after a chance discovery of a site at Soldiers Road where Slepe plantation backed onto an open area giving way to wet grazed pasture beyond. For quite some time this was the only known place to guarantee a woodcock sighting.
It was eventually realised that Soldiers Road wasn't the only place one could observe woodcock and that, if one stood at any decent sized plantation that backed onto open pasture, woodcock were likely to be encountered.

Although detection rates would clearly be insufficient to attempt any sort of population estimate with this method, it was decided that dusk commuting flight observations would provide a good starting point to at least determine the presence or absence of birds in any particular area, and perhaps also help establish some roosting and feeding areas that could be used for the pilot surveys.

3.1. Pilot surveys

Diurnal transects through conifer plantations were undertaken first. The first transect through Slepe plantation went well. Here the understorey was sparse with just a few scattered bracken areas, allowing straight line transects to be easily adhered to. Subsequent conifer plantation transects were more difficult. Many had considerable amounts of shrub strata such as rhododendron, gorse and bramble, ideal for woodcock but difficult to traverse in a reasonably straight line. Detouring around some of the smaller areas close enough to the transect line was possible

in many places, however large completely impenetrable stands of cover were often encountered, requiring significant deviations from the transect line. It was felt that, in doing so, birds on the transect line were potentially being missed. Distance sampling relies on the assumption that all birds on the transect line will be detected. In addition, registrations were quite low in terms of survey effort; distance sampling also requires a high number of registrations to produce accurate results.

A further issue was disturbance. Some of the plantations around the harbour were (and still are) in the process of being thinned or completely removed to return the areas to heathland habitat, so it wasn't entirely clear to what extent this would affect results.

Diurnal transects were also undertaken in a variety of other habitats including *Calluna* and gorse heathland, hedgerow with coppice and deciduous woodland. The latter two habitats proved particularly difficult to traverse, particularly those with a dense shrub strata and registrations in terms of survey effort were very low.

The nocturnal spot-lamping pilot surveys went very well and it was felt that registrations were representative. It was decided, therefore, that this method would be used to determine the harbour's population.

4. Methods

4.1 Dusk commuting flights

The aim of the dusk commuting flight surveys was to assess presence or absence of birds and to provide clues as to the locations of roosting and feeding areas.

To limit detection from predators, where possible woodcock prefer to fly at low levels, typically about 5 feet off the ground from roost sites close to feeding areas. A relatively obstacle-free flight path is preferred, allowing ideally a short, fast, low and direct flight. Typical sites include plantation or woodland edges or within those that contain clearings or rides.
Detecting a fast and low woodcock at dusk against a dark background is only really possible if one stands directly in front of the clearing or ride. Even then, many of the observations are almost subliminal. Fortunately (for the author) not all roost sites provided such a ride or clearing, resulting in birds being forced to rise above the tree line to create a detectable silhouette against the lighter sky.

Evenings with low cloud levels were chosen to provide a lighter sky and where possible facing west into the setting sun, although this was not always possible.

Initially, known sites were investigated and detection techniques tweaked. One innovation designed to aid detection of low level birds was to shine a beam of light across the start of the feeding area. However, birds tended to avoid the beam of light by either rising back up again or postponing their descent until they cleared the beam. Their reaction suggested that this method was unduly intrusive and so was abandoned.

A series of randomly scattered sites across the harbour encompassing a variety of habitat types were visited. For each site, weather details were taken including cloud cover. For each bird detected, a time was recorded and an estimated flight line plotted on a map along with height details.

4.2 Spot-lamp counts

The basic principle of spot-lamp counting is to scan an area with a high-powered torch and record the number of woodcock seen.

Previous spot-lamp counts and radio-tracking in winter have shown that woodcock have clear preferences for certain types of fields when feeding at night, with densities varying between particular field types.
All fields and other potential feeding areas were therefore categorised based on habitat type. For this, use was made of Duriez, O. *et al* (2004) *Habitat selection of the Eurasian woodcock in winter in relation to earthworms* which identified feeding activities in relation to field type and earthworm density.

Habitat types were categorised as follows:

Wet grazed permanent pasture (PPGW): permanent pasture with evidence of livestock and aquatic plants
Dry grazed permanent pasture (PPG): permanent pasture with evidence of livestock, no aquatic plants
Wet ungrazed permanent pasture (PPUGW): no evidence of livestock, presence of aquatic plants
Dry Ungrazed permanent pasture (PPUG): no evidence of livestock or aquatic plants
Ley grass (LG): grass in rotation with arable crops but currently grass.
Arable (A) - Crop fields, seed plots or bare soil

Unique to this survey were other potential feeding area habitat types:

Coastal and floodplain grazing (CFPG): characterised by a water table at or above ground level or proximity to tidal areas causing flooding for some part of the year, to include a mixture of pasture and aquatic plants
Purple Moor grass and Rush pasture (PMGRP): wet grassland on poorly drained soils that has not been agriculturally improved, dominated by moor grass *(Molinia*) and rush (*Juncus)*
***Calluna* and gorse heathland (CGH)**
Unimproved grassland dominated by scrub (UG)
Golf courses (GC)
Playing fields (PF)

Permanent pasture was identified by the lack of furrowing evidence or a general unevenness of height.

Ley grass was identified by signs of furrowing.
Grazed pasture was identified by evidence of livestock to include footprints or dung, past or present.

Assigning a habitat type to each field wasn't quite as straightforward as initally envisaged. A search through all the available habitat maps for Poole Harbour unfortunately yielded no information on field usage, meaning that each field had to be assessed by the author, all 451 of them!

Many fields could be identified during lamping sessions or other visits. A number of dedicated visits were however necessary, where use was made of high vantage points and a telescope.
Some fields were not accessible or viewable. Here, use was made of aerial photographs to compare areas of known habitat type to unknown habitat type. They also proved useful for determining the presence of cows etc, but not so great for spotting aquatic plants!
A very small percentage of areas defied all these methods and had to be excluded from the survey.

Each field was also given a unique code and its area calculated.

The recording area was divided into 24 arbitrary sectors for practical reasons, where possible following 'recognised' areas. This also enabled density data from individual sectors to be recorded and compared.

Densities calculated were then used to estimate numbers for the remaining areas not covered within that sector. Where the dataset was too small for extrapolation, density figures were pooled with neighbouring sector data to produce a likely representative density figure.

A high-powered torch was chosen which had 4 settings, the lowest was able to be used initially so as to not upset the more immediate birds. Beyond these distances, the power could gradually be increased to a range far beyond the author's limit of confidently identifying a woodcock. The main confusion risks being rabbit, lapwing and snipe. Clues such as eye colour, shape and darkness of silhouette and characteristics of movement were helpful pointers.
Woodcock have a number of predator avoidance techniques; being a cryptic bird their main line of defence is to keep still. The response of the birds to some extent can be predicted based on weather conditions, moon phases and detectability of the surveyor. Woodcock are known to be more restless during full moon periods feeling more vulnerable, particularly on cloudless nights. On dull overcast nights they are less likely to flush. It was hoped that surveys could be undertaken during new moon periods on overcast nights.

Lamping was carried out where possible from field edges to avoid disturbance. In cases where it was not possible to lamp the whole of the field, arcs of view were estimated.

For 'wet' fields and coastal and floodplain grazing areas that contained numerous stands of taller vegetation such as *Juncus*, it was necessary to enter the area. Although not previously used before on woodcock, this method was employed in *Winter habitat use and diet of the Common Snipe in south west England* Hoodless (2000) to collect data on Common Snipe densities, which are also nocturnal pasture foragers.

A potential issue with entering fields is the spectre of double counting. All flushed birds have the potential to fly to another area and be counted again later in another place. Therefore, before the survey began, some investigations were undertaken to try to establish likely distances and perhaps directions flown by flushed birds. This information proved difficult to find, apart from anecdotal experiences of those involved in shoots. The conclusion seemed to be that some flew short distances and some longer distances with birds that got shot apparently not flying so far! It was, however, noted that woodcock do have a tendency to double back when flushed which would prove useful.

All birds flushed were followed where possible to try to determine the approximate landing location.

Another possible area of concern with this method is the potential to re-count previously disturbed birds on a subsequent evening at another site. Woodcock are known to be very field loyal and will visit the exact same field on many consecutive nights if there is good feeding. O Duriez (2005), with the use of radio-tagged birds, indicated that birds flushed accidentally usually returned to the same site in the following days (a site identified here as a core area with a radius of 120 metres). With this in mind, adjacent sites were visited, where possible, at least 3 days apart to allow previously flushed birds to resume their usual routine.

Many studies have found that woodcock will remain faithful to one area for an entire winter. Wilson (1979) for example, re-trapped 63 birds within the same winter period an average distance of just 75 metres away from the original site trapped.

It was hopeful therefore that the majority of birds lamped during the survey would involve different birds.

Fig 1. Poole Harbour woodcock recording sectors

5. Timing

5.1 Dates

The first woodcock start to arrive in southern England in the 3rd or 4th week of October, usually associated with a full moon. The largest influx generally occurs during the November full moon or 'The Woodcock moon' as it is sometimes known. Migrants can, however, continue to arrive up until late December particularly if the weather is mild on the continent, when they will be less inclined to move. Up until this time, immigration and emigration can still occur (Hoodless 1994).
By January, assuming temperatures do not drop significantly, the population should then be stable, with birds usually staying very faithful to their chosen wintering areas (Duriez *et al* 2005).
Dedicated population density counts were therefore not started until January, continuing until the first week of March.

Dusk commuting flight observations began as soon as the first birds started to arrive. Pilot diurnal and nocturnal surveys commenced in December.

5.2 Time

Previous surveys have indicated that woodcock most actively feed in the first hours of darkness. In mild weather they can return to their diurnal roosting sites long before dawn, having fed well.
Radio-tagging has shown that a small percentage of birds can leave roost sites later than dusk under complete cover of darkness. All lamping sessions were therefore started at least 90 minutes after dusk, finishing no later than 1am.

6. Results

6.1 Dusk commuting flight findings

The aim of the dusk flight surveys was to assess presence or absence of birds and to provide clues as to the locations of roosting and feeding areas. However, some interesting data were found and are presented here, although it must be stressed that results and assumptions are based on qualitative rather than quantitative data.

As alluded to earlier, dusk flights were recorded at many sites throughout the harbour. Although observations did provide good indications of likely roosting and feeding sites, determining exact emergence and destination positions was not possible unless they coincided with the position of the observation point. Some emergence sites were identified this way to include conifer plantation edges, hedgerow, deciduous woodland edges and even isolated small bushes a few feet from the observer.

All observation points adjacent to conifer plantations recorded birds leaving from their direction.

Emergence times were found to be very consistent. Since the efficiency of diurnal raptors declines abruptly with darkness, woodcock are assumed to use illumination levels as a cue to leave the roost. It was found that emergence times did suggest a correlation with light levels, with birds leaving earlier in full cloud cover compared to evenings with nil cloud cover. Clearly, any birds leaving well after dark would not have been detected, however it was felt that on most occasions after the last bird had been seen any further birds would have been detectable for some time afterwards.

Cloud cover (oktas)	Earliest and latest emergence times after sunset (mins)	Average emergence time after sunset (mins)
8/8	33-40	35
3/8	38-46	41
0/8	41-47	44

Table 1. Woodcock emergence times in relation to cloud cover during the last 2 weeks of November

The difference in average emergence times between 8 oktas cloud cover and 0 oktas was 9 minutes which, rather neatly, equates to 1 minute per okta difference.

Emergence time periods between the first and last birds out (excluding the odd tardy straggler) ranged from 1 to 8 minutes (The one minute time period only involving 2 birds).

From mid November to mid December (all dusk flight surveys were done during this period), another pattern seemed to emerge which on the face of it appears rather odd. The average emergence times after sunset (for any given amount of cloud cover) were slightly earlier in December. This does seem to be at odds with a rather detailed survey undertaken in Spain (Braña *et al* 2010). It was found here that emergence times in December were later than November and suggested this fitted with the theory that in November newly arrived and transient birds were not at their optimum weight and so commuted earlier for extra feeding.

Not so at odds however, if one considers that westward migration of many birds in 2013 was delayed due to the mild continental conditions and the December birds were also new arrivals.

Previous studies have established that birds of the year migrate earlier than adults and were more likely to have been the November arrivals. This winter the Game & Wildfowl Conservation Trust indeed noted from ringing that birds of the year made up 90% of the birds ringed in November.

The maximum number of commuting birds recorded for any one visit was 8, which occurred twice at the southern boundary of The Moors. On one occasion two observers were present. The main limiting factor to the number of birds recorded was the limit of the effective observation distance, which varied between sites and evenings dependent upon obstacles and backdrop light levels.

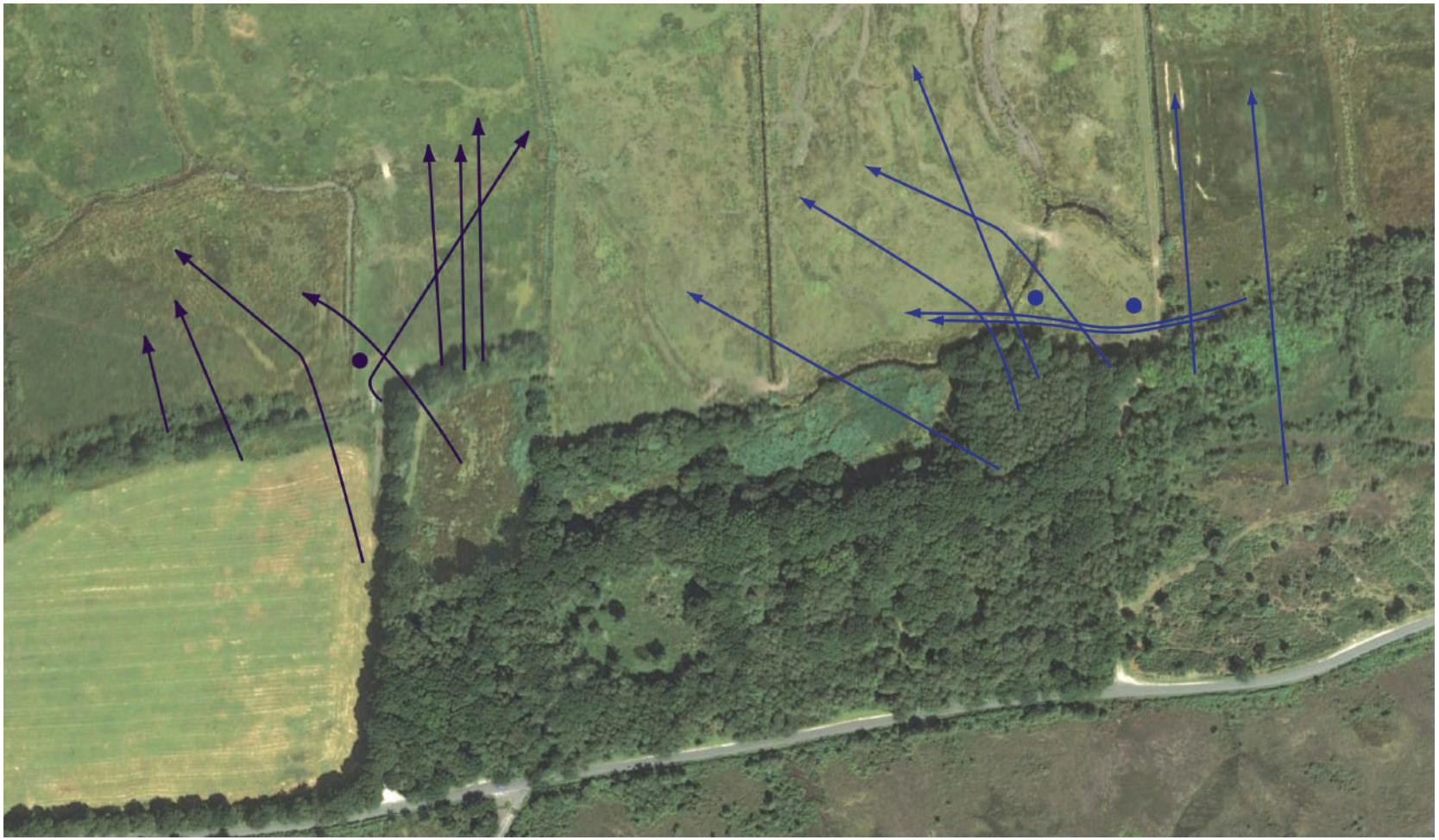

Fig 2. Woodcock commuting flights to The Moors over two consecutive evenings. Arrows represent observed flights. Length of arrow only represents portion of flights observed and do not indicate start or finishing positions of the birds. Dots represent position of observers. (2 observers used at easterly VP).

It could well have been that the 16 registrations over the two evenings involved 16 different birds. As previously alluded to, woodcock are very faithful to their chosen roosting and feeding site and, as such, will often have the same commuting flight route night after night.

As expected, woodcock were encountered at many sites throughout the harbour and it soon became apparent that a population density estimate would have to include virtually all parts of the harbour.

6.2 Spot-lamping results

6.2.1 Summary of results

In total, 1077 ha (10.77 sq. km) of potential feeding area were lamped out of a total potential available area of 1982 ha, representing a 54% coverage.

The total number of birds recorded was 452.

Using density figures based on habitat type, an additional 192 birds were estimated to be present, bringing the total estimated Poole Harbour wintering woodcock population to 644 birds.

The highest densities occurred in wet grazed permanent pasture where an average of 76 birds per sq. km was recorded.

The lowest densities, aside from habitats completely avoided, were found in ungrazed 'dry' permanent pasture with 8 birds per sq. km recorded.

Pooling density figures for the 4 permanent pasture types gave a combined figure for 'pasture' of 43 birds per sq.km

The average density over all habitat types that recorded birds was 32.5 birds per sq. km.

The most densely populated areas were fields west of Stoborough Heath at Sunnyside and pasture south of Middlebere Heath, both respective sectors recording densities of 72 birds per sq. km. Other high density areas were Hartland (60 birds per sq km), The Moors (50 birds per sq km) and Middlebere (43 birds per sq km) with localised high densities also occurring at Ower and the Frome Valley.

Fields at Holes Bay and fields in the vicinity of Studland village recorded no birds.

6.2.2 Results by habitat

Habitat type	Code	Area lamped (ha)	Count	Density (per ha)	Density (per km^2)	Total area within harbour (ha)	% of total habitat type
Wet grazed permanent pasture	PPGW	325.94	247	0.76	76	406.11	20.5
Coastal and floodplain grazing	CFPG	59.66	45	0.75	75	99.64	5.0
Purple moor grass and rush pasture	PMGRP	17.8	8	0.45	45	20.8	1.0
Wet ungrazed permanent pasture	PPUGW	66.04	23	0.35	35	134.93	6.8
'Dry' grazed permanent pasture	PPG	421.57	109	0.26	26	798.85	40.3
Arable	A	34.3	5*	0.12	12	112.29	5.7
Ley grass	LG	56.71	7	0.12	12	162.46	8.2
'Dry' ungrazed permanent pasture	PPUG	95.13	8	0.08	8	247.03	12.5
All permanent pasture		*908.68*	*387*	*0.43*	*43*	*1586.92*	*80.1*

Table 2. Habitat selection of wintering woodcock, ranked in order of preference. (Habitat types that recorded no birds are excluded)

** One of the arable fields contained a permanent grass strip which recorded one woodcock. The density calculations for this habitat type therefore use a count of 4 birds.*

Woodcock are known to prefer soft rather waterlogged grazed permanent pasture for winter-feeding in preference to all other habitat types. Results in Poole Harbour agreed, with the most densely populated habitat being wet grazed permanent pasture (PPGW), very closely followed by Coastal and floodplain grazing (CFPG) areas. These two habitat types, particularly during periods of high rainfall are very similar in so far as both are a waterlogged mixture of pasture and aquatic plants. The closeness of density values is therefore not surprising.

Areas classified as Purple moor grass were only available for feeding on The Moors. This area was also similar to CFPG being grazed by the local livestock. It included more extensive areas of taller stands of vegetation and recorded a lower density of birds at T.

Woodcock are known to prefer short grass to long grass. Wet ungrazed pasture may therefore have been expected to return a lower density of birds given the potential sward height of the grass. Some of these fields however, although having no evidence of livestock, did have short grass.

Ley grass and Arable fields recorded the second lowest feeding densities. The least favoured habitat type that recorded birds was 'dry' ungrazed permanent pasture.
Areas of heathland, golf course, playing field and unimproved grassland dominated by scrub were also lamped but no birds were found.

It was estimated that a total of 340 ha of mainly coastal and floodplain grazing were lost to flooding, the implications of this for density figures are discussed in section 8.2.

6.2.3 Results by sector

Site	Area (ha) available	Area (ha) lamped	Count	Recorded Density	Area (ha) not lamped	Estimated additional birds	Estimated population	Estimated Density (km^2)
Stoborough & Sunnyside	78.65	64.93	54	0.83	13.72	3	57	72
Gallows & New Mills Heath	127.23	106.09	87	0.82	21.14	5	92	72
Hartland	26.62	24.6	16	0.65	2.02	0	16	60
The Moors	87.55	76.29	39	0.51	11.26	5	44	50
Middlebere	101.9	66.2	33	0.50	35.7	11	44	43
Arne	28.87	28.87	12	0.42	0	0	12	42
Keysworth	128.99	17.17	0	-	112.32	50	50	39
Corfe Valley & Wytch south	99.79	47.36	23	0.49	52.43	15	38	38
Bushey	227.2	115.9	39	0.34	111.3	44	83	37
Ower & Fitzworth	121.51	60.79	36	0.59	60.72	7	43	35
Burnbake & Claywell	31.32	20.85	7	0.34	10.47	4	11	35
Frome Valley west	126.86	79.99	39	0.49	46.87	4	43	34
Swineham	22.05	0	-	-	22.04	7	7	32
Norden	57.46	49.98	16	0.32	7.48	1	17	30
Greenlands	56.99	44.26	11	0.25	12.74	6	17	30
Godlingston	72.27	29.19	11	0.38	43.08	8	19	26
Lytchett Bay	41.65	29.7	5	0.17	11.95	3	8	19
Foxground	137.08	86	15	0.17	51.08	5	20	15
East Holton	39.09	37.13	5	0.13	1.96	0	5	13
Wytch	61.06	42.68	4	0.12	18.38	3	7	10
Ballard	144.23	0	-	-	144.23	11	11	8
Frome Valley east	18.5	7.69	0	0	10.36	0	0	0
Studland	74.35	27.34	0	0	47.01	0	0	0
Holes Bay	59.02	14.14	0	0	44.88	0	0	0

Table 3. Woodcock numbers by sector, ranked in descending order of estimated density

Stoborough & Sunnyside
Area (ha): 78.65
Habitat: Dominated by wet grazed permanent pasture

	PPGW	PPG	PPUGW	PPUG	LG	TOTAL
Area lamped (ha)	46.54	11.55	0	3.82	3.02	64.93
Count	52	2	-	0	0	54
Density recorded (per ha)	1.12	0.17	-	0	0	0.83
Area not lamped (ha)	1.54	6.1	2.14	3.94	0	13.72
Estimated count for area not lamped	2	1	0	0	0	3
Estimated total population	54	3	0	0	0	57

Table 4. Population and density figures by habitat type Stoborough and Sunnyside

PPGW fields here recorded an astonishing 112 birds per sq. km.
Conditions here were pretty much perfect for woodcock with all their boxes ticked.

It does seem likely that this figure was achieved with the help of displaced birds from nearby flooded areas. (Discussed in section 8.2)

Evidence of clustering noted, as at many other sites.

Fig 3. Distribution of feeding woodcock Stoborough & Sunnyside (dots: individual birds, lamped areas in colour)

Gallows & New Mills Heath
Area (ha): 127.23
Habitat: Dominated by wet grazed permanent pasture

	PPGW	PPG	PPUGW	PPUG	TOTAL
Area lamped (ha)	93.76	8.41	2.73	1.19	106.09
Count	86	0	1	0	87
Density recorded (per ha)	0.92	0	0.37	0	.82
Area not lamped (ha)	0	6.6	12.75	1.79	21.14
Estimated count for area not lamped	0	0	5	0	5
Estimated total population	86	0	6	0	92

Table 5. Population and density figures by habitat type Gallows & New Mills Heath

Very impressive numbers here also. All birds except one recorded in PPGW.

Main livestock was sheep.

Clustering of birds at favourable patches evident.

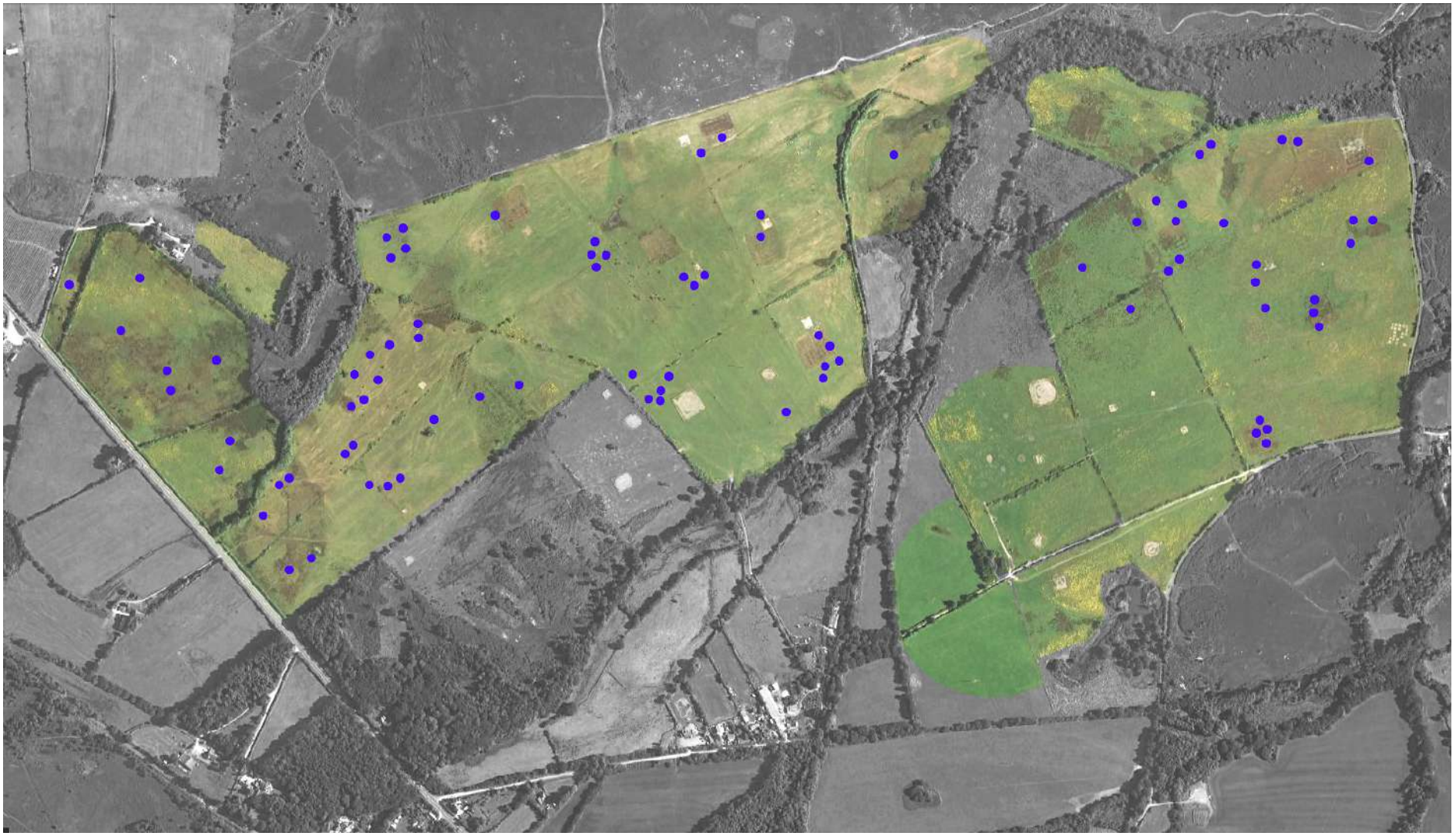

Fig 4. Distribution of feeding woodcock Gallows & New Mills Heath (dots: individual birds, lamped areas in colour)

Hartland
Area (ha): 26.62
Habitat: Dominated by grazed permanent pasture

	PPGW	PPG	Total
Area lamped (ha)	17.65	6.95	24.6
Count	16	0	16
Density recorded (per ha)	0.9	0	.65
Area not lamped (ha)	0	2.02	2.02
Estimated count for area not lamped	0	0	0
Estimated total population	16	0	16

Table 6. Population and density figures by habitat type

Although only a small sector, 16 birds were found representing the third highest sector density of the survey.

All birds were recorded in PPGW with none in PPG.
Distribution map shows strong preferences for certain parts of fields.

Fig 5. Distribution of feeding woodcock Hartland (dots: individual birds, lamped areas in colour)

The Moors
Area (ha): 123.55
Habitat: Dominated by Coastal and Floodplain grazing (CFPG) with some purple moor grass and rush pasture (PMGRP). Both areas grazed by cattle.

	PPUGW	CFPG	PMGRP	TOTAL
Area lamped (ha)	8.79	49.7	17.8	76.29
Count	0	31	8	39
Density recorded (per ha)	0	0.62	0.45	0.51
Area not lamped (ha)	2.56	5.7	3	11.26
Estimated count for area not lamped	0	4	1	5
Estimated total population	0	35	9	44

Table 7. Population and density figures by habitat type The Moors

Lamping here was undertaken after significant areas of the flooding had subsided. The implications of which are discussed in section 8.2.

As with other areas, clustering of birds evident.

Approximately 36 ha of CFPG and 4 ha of PMGRP were lost to flooding and formed no part of the calculations.

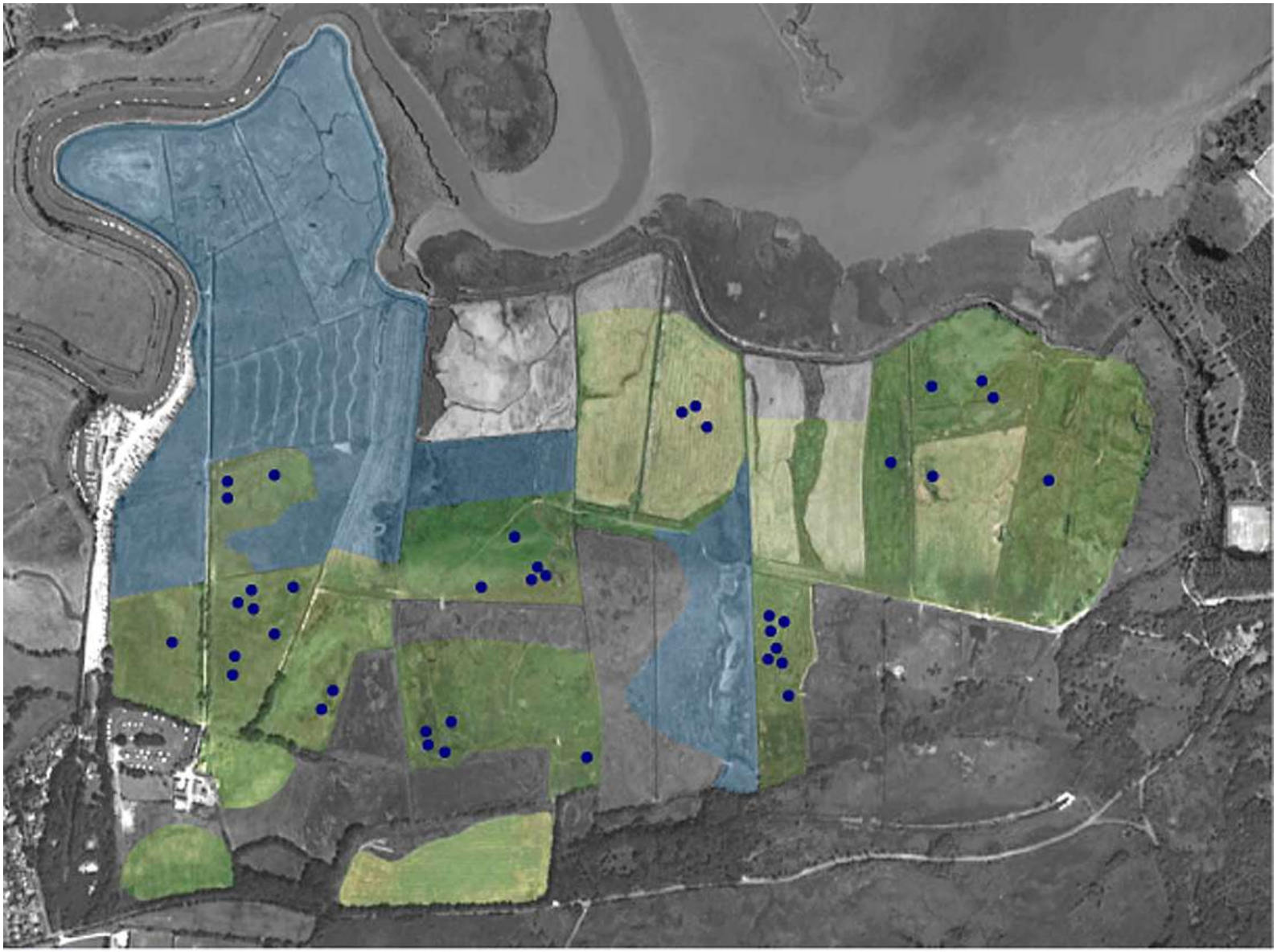

Fig 6. Distribution of feeding woodcock The Moors (dots: individual birds, flooded areas blue, lamped areas remaining colours)

Middlebere
Area (ha): 101.9
Habitat: Dominated by permanent pasture

	PPGW	PPG	PPUGW	PPUG	LG	CFPG	Total
Area lamped (ha)	24.57	10.14	10.26	4.25	10.72	6.26	66.2
Count	9	5	11	1	0	7	33
Density recorded (per ha)	0.37	0.49	1.07	0.23	0	1.12	.5
Area not lamped (ha)	20.47	4.73	0	9.85	0.65	0	35.7
Estimated count for area not lamped	7	2	0	2	0	0	11
Estimated total population	16	7	11	3	0	7	44

Table 8. Population and density figures by habitat type Middlebere

Uniquely for this sector, PPG fields returned a higher density of birds than PPGW. As with other areas, exceptionally high rainfall resulted in many of the usually 'dry' fields being waterlogged to the extent normally reserved for 'wet' fields. This, combined with the possible over-saturation of some of the 'wet' fields could have been the cause for the turnaround.

There was also an exceptionally high density recorded for wet ungrazed permanent pasture. Although there were no signs of livestock, much of the grass was sufficiently low to be attractive for feeding.

As can also be seen from the distribution map below (Fig 7) all ley grass fields were completely avoided (cream areas in the south west corner)

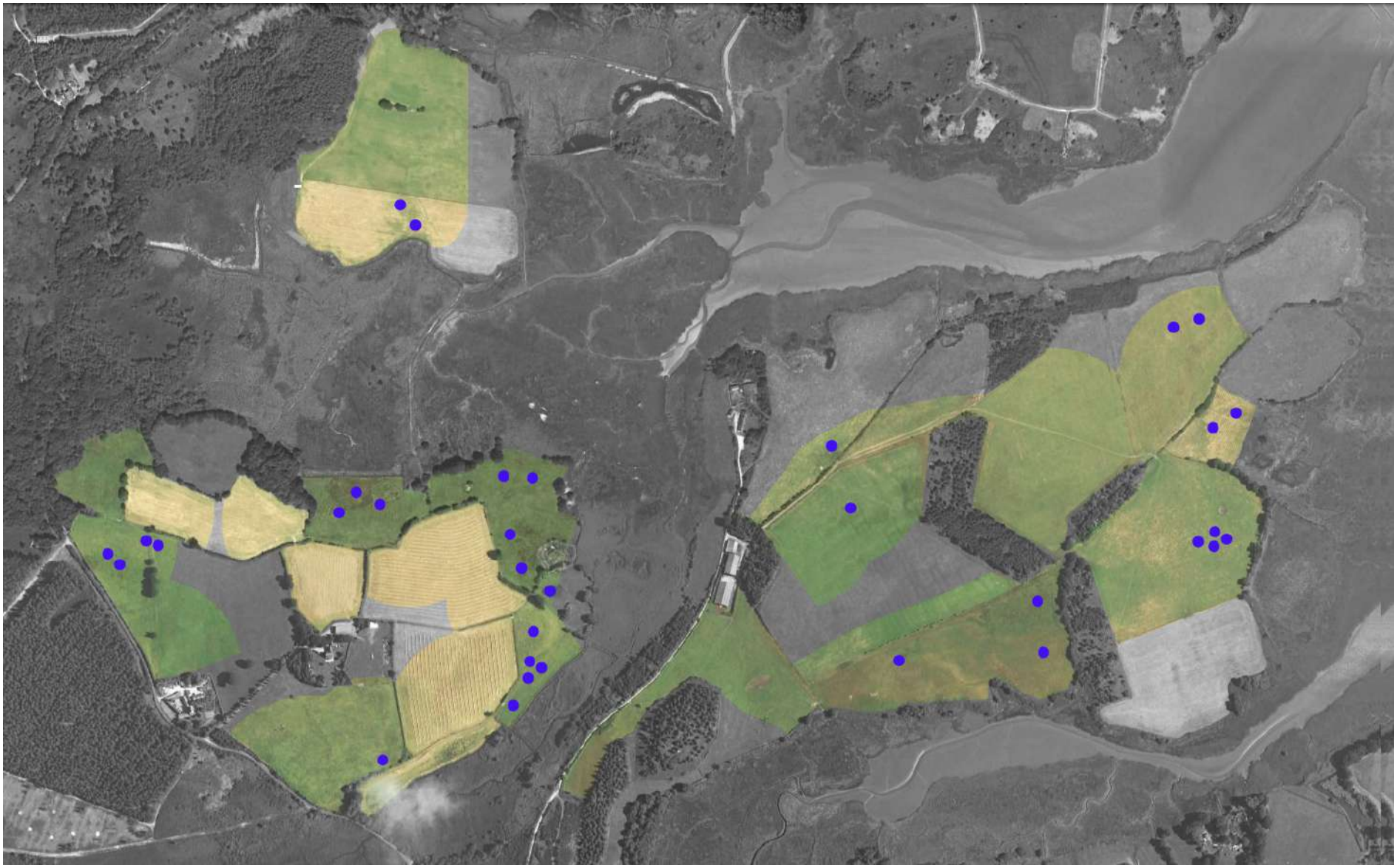

Fig 7. Distribution of feeding woodcock Middlebere (dots: individual birds, lamped areas in colour)

Arne
Area (ha): 28.9
Habitat: All grazed permanent pasture

The average density figure of 0.41 birds per ha belies the uneven distribution, with the majority of birds concentrated in one field.
The popular field was of the same habitat type to the others but with the distinction of a high perimeter fence.

Such a fence would deter all land-based predators, it would also keep out the large numbers of sika deer which have the potential to disturb feeding woodcock.

Fig 8. Distribution of feeding woodcock Arne (dots: individual birds, lamped areas colour)

Keysworth
Area (ha): 162.99
Habitat: Mainly Coastal and floodplain grazing and permanent pasture dominated by livestock farming**.**

	PPGW	PPG	CFPG	Total
Area lamped (ha)	-	19.85	-	19.85
Count	-	0	-	0
Density recorded (per ha)	-	0	-	0
Area not lamped (ha)	16.36	61.68	34.28	112.32
Estimated density	0.7	0.3	0.62	0.45
Estimated count for habitat not lamped	11	18	21	50
Estimated total population	11	18	21	50

Table 9. Estimated population and density figures by habitat type Keysworth

Access was not possible to the Drax Estate. Densities were estimated using data from relevant other sectors.
A number of fields were accessible or viewable from beyond the estate, which were covered. They were in close proximity to human habitation and no birds were found. It was estimated that 50 birds were using the area.

Approximately 34 ha of coastal and floodplain grazing were lost to flooding.

Corfe Valley & Wytch south
Area (ha): 99.79
Habitat: Permanent pasture

	PPGW	PPG	PPUGW	PPUG	TOTAL
Area lamped (ha)	5.04	25.4	14.22	2.7	47.36
Count	4	16	3	0	23
Density recorded (per ha)	0.79	0.63	0.21	0	0.49
Area not lamped (ha)	3.63	13.1	16.57	19.13	52.43
Estimated count for area not lamped	3	8	4	0	15
Estimated total population	7	24	7	0	38

Table 10. Population and density figures by habitat type Corfe Valley & Wytch south

Good concentration of birds in 3 large waterlogged fields south of Wytch Heath.

Some of the birds feeding in the small fields of the Corfe Valley (left hand side of distribution map below) were very close to boundary hedges. This was also found to be the case at a number of other sites, which was contrary to the findings in (Hoodless 1994) which noted that all birds completely avoided the first 20 metres of fields.

Fig 9. Distribution of feeding woodcock Corfe Valley & Wytch south (dots: individual birds, lamped areas in colour)

Bushey
Area (ha): 227.2
Habitat: Permanent pasture, arable and ley grass

	PPGW	PPG	PPUGW	PPUG	LG	A	Total
Area lamped (ha)	11.6	38	3.4	16.8	19.8	26.3	115.9
Count	4	15	1	7	7	5	39
Density recorded (per ha)	0.34	0.39	0.29	0.42	0.35	0.19	0.34
Area not lamped (ha)	13.6	43.3	3.8	38.8	8.4	3.4	111.3
Estimated count for area not lamped	6	17	1	16	3	1	44
Estimated total population	10	32	2	23	10	6	83

Table 11. Population and density figures by habitat type Bushey

As with many sectors, many of the fields were waterlogged resulting in a reasonable density of birds in PPG fields.

Seven birds in one single 6 ha ley grass field represented the sum total of birds lamped within this habitat during the entire survey. These were unusually boggy and waterlogged.

One of only 4 sectors to contain arable fields. Bushey was the only sector to record birds feeding within this habitat. (The arable fields at Ballard could not be surveyed)

As can be seen on the distribution map below, some birds appear to be feeding in lines. Although birds can obviously randomly occur in lines, the positions of many of these feeding birds often matched the progress of water courses within the fields.

For easier presentation of results two maps for the sector have been used.

Fig 10. Distribution of feeding woodcock Bushey (west) (dots: individual birds, lamped areas in colour)

Fig 11. Distribution of feeding woodcock Bushey (east) (dots: individual birds, lamped areas in colour)

Ower & Fitzworth
Area (ha): 121.51
Habitat: Dominated by grazed permanent pasture

	PPGW	PPG	PPUGW	PPUG	Total
Area lamped (ha)	25.7	26.71	3.23	5.15	60.79
Count	22	12	2	0	36
Density recorded (per ha)	0.86	0.45	0.62	0	0.59
Area not lamped (ha)	0	31.36	2.08	27.28	60.72
Estimated count for area not lamped	0	6	1	0	7
Estimated total population	22	18	3	0	43

Table 12. Population and density figures by habitat type Ower & Fitzworth

One of the highest PPGW densities recorded with 0.86 birds per ha (86 birds per sq.km)

Clustering of birds clearly evident. Concentrations occurring mostly in particularly waterlogged areas with stands of *Juncus*

Some extensive areas with no birds at all.

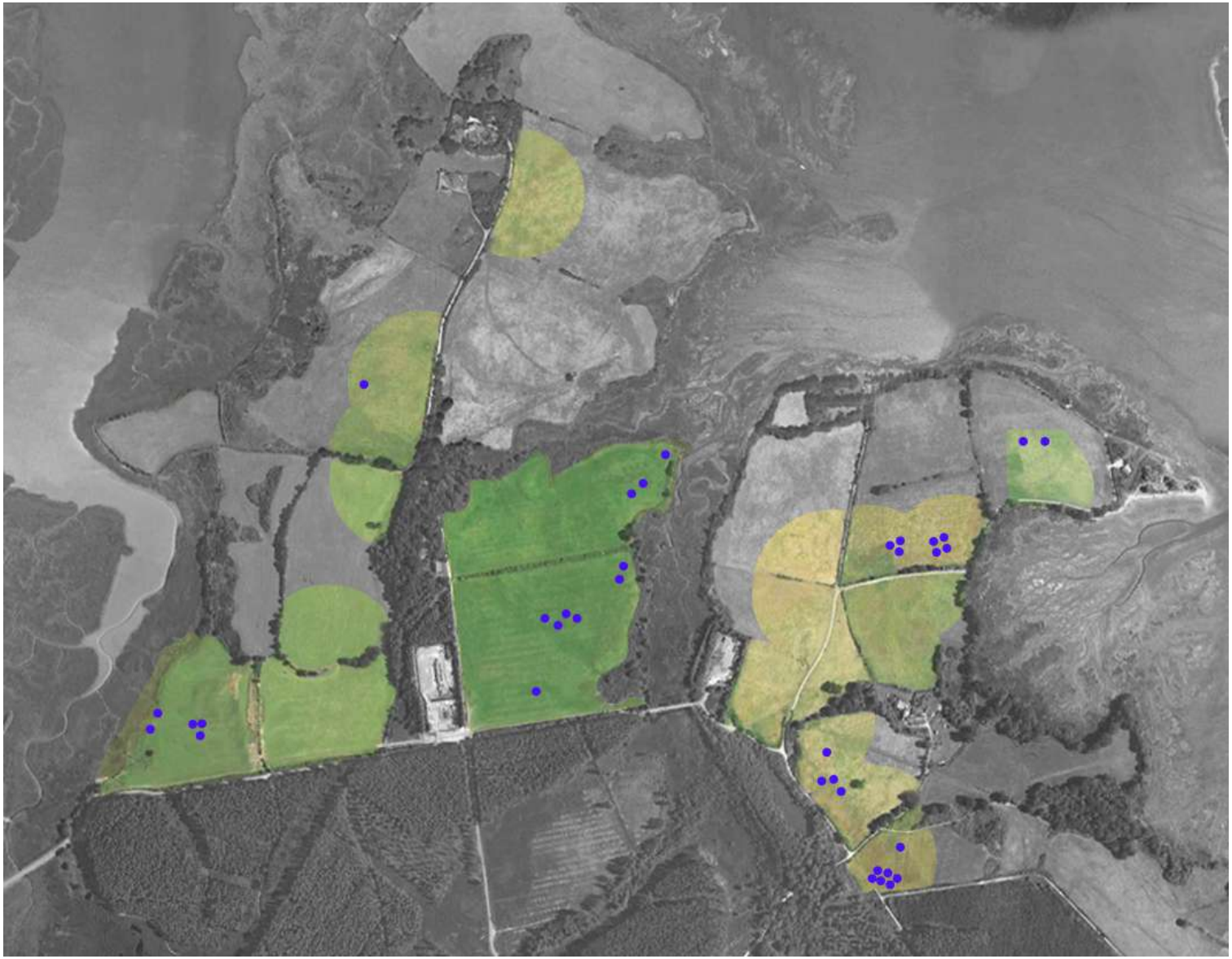

Fig 12. Distribution of feeding woodcock Ower & Fitzworth (dots: individual birds, lamped areas in colour)

Burnbake & Claywell
Area (ha): 31.32
Habitat: Mainly grazed permanent pasture

	PPGW	PPG	PPUGW	Total
Area lamped (ha)	0	17.78	3.07	20.85
Count	-	7	0	7
Density recorded (per ha)	-	0.39	0	0.34
Area not lamped (ha)	4.13	3.73	2.61	10.47
Estimated count for area not lamped	3	1	0	4
Estimated total population	3	8	0	11

Table 13. Population and density figures by habitat type

All birds within this small sector favoured a particular couple of fields

Fig 13. Distribution of feeding woodcock Burnbake & Claywell (dots: individual birds, lamped areas in colour)

Frome Valley west

Area (ha): c225
Habitat: Mainly grazed permanent pasture and floodplain grazing

	PPGW	PPG	PPUGW	PPUG	LG	A	CFPG	Total
Area lamped (ha)	32.06	7.74	15.8	16.94	3.75	0	3.7	79.99
Count	27	0	5	0	0	-	7	39
Density recorded (per ha)	0.84	0	0.32	0	0	-	1.9	0.49
Area not lamped (ha)	4.7	6.62	3.43	12.13	16.49	3.5	0	46.87
Estimated count for area not lamped	3*	0	1	0	0	0	0	4
Estimated total population	30	0	6	0	0	0	7	43

Table 14. Population and density figures by habitat type Frome Valley west

**Due to the significant differences in densities between the same habitat type on either side of the valley, for extrapolation purposes the respective densities were calculated separately. Therefore, although the overall recorded density for PPGW was 0.84 birds per ha, this value was not used in the calculations for fields south of the river.*

Extensive flooding produced some good concentrations of birds on the higher ground, particularly the grazed permanent pasture south of Worgret Manor Farm, which despite its elevation was extensively waterlogged.
A small area of floodplain that had escaped the flooding held 7 birds in an area only 3.7 ha.

Perfectly good wet grazed permanent pasture was available on the southern side of the river but contained few birds. Apart from elevation, many of these areas were similar in all other respects to areas north of the river, including saturation levels.

Fig 14. Distribution of feeding woodcock Frome Valley west (dots: individual birds, flooded areas blue, lamped areas remaining colours)

Swineham
Area: 74.05
Habitat: Mainly Coastal and floodplain grazing, some grazed permanent pasture

	PPG	PPUGW	PPUG	Total
Area not lamped (ha)	16.48	4.76	0.8	22.04
Estimated density	0.3	0.44	0	0.32
Estimated count	5	2	0	7
Estimated total population	5	2	0	7

Table 15. Estimated population and density figures by habitat type Swineham

Much of this sector was under water with approximately 52 ha of Coastal and floodplain grazing and 25 ha of purple moor grass and rush pasture lost to flooding. Densities of the few remaining fields in the sector have been estimated from neighbouring sectors.

Norden
Area (ha): 57.47
Habitat: Permanent pasture.

	PPGW	PPG	PPUG	TOTAL
Area lamped (ha)	8.47	33.16	8.35	49.98
Count	0	16	0	16
Density recorded (per ha)	0	0.48	0	.32
Area not lamped (ha)	0	1.91	5.57	7.48
Estimated count for area not lamped	0	1	0	1
Estimated total population	0	17	0	17

Table 16. Population and density figures by habitat type Norden

Norden recorded the third highest density of the survey for PPG fields with all birds recorded in this sector being within this habitat. Surprisingly, no birds were found in the rather large PPGW field in the far north of the sector and was the only significantly sized PPGW field in the entire survey not to record a feeding woodcock. The field looked ideal and one can only speculate as to the reasons but perhaps a significant disturbance had occurred here just prior to the visit.

Only 4 of the 13 fields were occupied, 3 of which held all their birds in one particular area of that field.

Fig 15. Distribution of feeding woodcock Norden (dots: individual birds, lamped areas in colour)

Greenlands
Area (ha): 56.99
Habitat: Dominated by permanent pasture

	PPGW	PPG	PPUG	Total
Area lamped (ha)	5.4	38	0.85	44.25
Count	8	3	0	11
Density recorded (per ha)	1.48	0.08	0	0.25
Area not lamped (ha)	6	5.37	1.37	12.74
Estimated count for area not lamped	6	0	0	6
Estimated total population	14	3	0	17

Table 17. Population and density figures by habitat type Greenlands

Rather sparsely populated apart from the PPGW area in the south of the sector which held 8 birds in a 5.4 ha area. No birds were found in the smaller fields to the north of the sector.

Evidence here of birds feeding very close to boundary hedges.

Fig 16. Distribution of feeding woodcock Greenlands (dots: individual birds, lamped areas in colour)

Godlingston
Area (ha): 72.27
Habitat: Mostly permanent pasture with some ley fields and part of a golf course

	PPG	PPUG	LG	Total
Area lamped (ha)	26.9	2.27	0	29.17
Count	11	0	-	11
Density recorded (per ha)	0.41	0	-	0.38
Area not lamped (ha)	21.4	2.78	18.9	43.08
Estimated count for area not lamped	8	0	0	8
Estimated total population	19	0	0	19

Table 18. Population and density figures by habitat type Godlingston

Birds rather sporadically distributed with 4 fields containing just one bird.

No birds recorded within the golf course areas.

Fig 17. Distribution of feeding woodcock Godlingston (dots: individual birds, lamped areas in colour)

Lytchett Bay
Area (ha): 41.65
Habitat: Predominantly permanent pasture and floodplain grazing

	PPGW	PPG	PPUGW	A	Total
Area lamped (ha)	9.9	10.26	1.54	8.0	29.7
Count	3	2	0	0	5
Density recorded (per ha)	0.3	0.19	0	0	0.17
Area not lamped (ha)	2.42	9.53	0	0	11.95
Estimated count for area not lamped	1	2	0	0	3
Estimated total population	4	4	0	0	8

Table 19. Population and density figures by habitat type Lytchett Bay

Five birds found and 8 birds estimated to be present

Approximately 14 ha of Coastal and floodplain grazing were lost to flooding, almost certainly resulting in a lower count than would have otherwise occurred.

Foxground
Area (ha): 137.08
Habitat: Permanent pasture and ley grass fields

	PPGW	PPG	PPUG	LG	Total
Area lamped (ha)	15.76	59.56	0	10.68	86
Count	8	7	-	0	15
Density recorded (per ha)	0.5	0.12	-	0	0.17
Area not lamped (ha)	4.8	28.41	8.15	9.72	51.08
Estimated count for area not lamped	2	3	0	0	5
Estimated total population	10	10	0	0	20

Table 20. Population and density figures by habitat type Foxground

Birds in this sector were concentrated in very specific areas of PPGW and PPG apart from a lone bird in the far eastern corner.

Fig 18. Distribution of feeding woodcock Foxground (dots: individual birds, lamped areas in colour)

East Holton
Area (ha) 39.09
Habitat: Permanent pasture

5 birds found, 4 in PPGW and one in PPG

Fig 19. Distribution of feeding woodcock East Holton (dots: individual birds, lamped areas in colour)

Wytch
Area (ha): 61.06
Habitat: Dominated by grazed permanent pasture

	PPGW	PPG	PPUGW	PPUG	Total
Area lamped (ha)	16.85	20.63	0	5.2	42.68
Count	4	0	-	0	4
Density recorded (per ha)	0.24	0	-	0	0.12
Area not lamped (ha)	2.52	5.08	10.37	0.41	18.38
Estimated count for area not lamped	1	0	2	0	3
Estimated total population	5	0	2	0	7

Table 21. Population and density figures by habitat type Wytch

Four birds in just under 17 ha of PPGW lamped was the lowest density for this habitat type of the survey and particularly odd given the proximity to Middlebere, which recorded the 4th highest density figures of the survey for that habitat. One must assume that factors other than habitat type were influential.
One can only speculate as to the reasons but the proximity of the oil terminal, which is in operation day and night, may well have consequences for feeding and roosting birds.

Fig 20. Distribution of feeding woodcock Wytch (dots: individual birds, lamped areas in colour)

Ballard
Area (ha): 144.23 ha
Habitat: Mainly arable farming

Unfortunately permission could not be obtained to lamp any of the fields in this sector. Densities were estimated using data from other sectors.

	PPG	LG	A	Total
Area not lamped (ha)	43.46	33.98	66.79	144.23
Estimated density (ha)	0.12	0	0.1	0.08
Estimated count	5	0	6	11
Estimated total population	5	0	6	11

Table 22. Population and density figures by habitat type Ballard

Frome Valley east
Area (ha): 87.4
Habitat: Dominated by floodplain grazing

All areas of floodplain grazing (69 ha) were lost to flooding.
The only fields able to be lamped were unfavourable 'dry' ungrazed pasture, recording no birds.

Fig 21. Frome Valley east showing extent of flooding and fields lamped (areas to north of river and west of bypass were also flooded but lie within other sectors so are not marked as flooded here)

Studland
Area: 74.35
Habitat: Mostly horse paddocks with some unimproved grassland

A total of 39.4 ha of PPG, 3 ha of PPUGW and 12.34 ha of PPUG were lamped. All gave nil results.
Possible reasons could be proximity of human habitation with associated disturbance and noise levels.

Small field sizes could also be a factor and have been regarded as an issue in previous surveys. During this survey some birds were recorded in similar sized fields in other sectors, but these were always near to larger fields.

Fig 22. Frome Valley east showing areas lamped (in colour)

Holes Bay
Area (ha): 59.02
Habitat: Mix of grazed permanent pasture, arable and ley grass

A total of 7 fields of grazed permanent pasture and ley grass were part lamped.
No birds were found.

Fig 23. Holes Bay showing areas lamped (in colour)

7. Transect findings

Although transects were not continued after the pilot studies, as discussed in section 3 Determining methods, some interesting data were obtained and so are presented here.
It must be stressed, however, that figures and resultant attempted interpretations are based on very small sample sizes potentially containing large margins of error and must be regarded as speculative.

7.1 Conifer plantations

Slepe plantation was covered first, being known to contain birds. It lies immediately to the south of The Moors and for many years has been the most reliable site to see commuting woodcock in the harbour, being conveniently placed between what is now known to be two of the most important feeding areas of the harbour. It is currently 20% of its original size and is earmarked for complete removal.
The plantation has a sparse shrub strata of bracken, otherwise there is no cover.
A total distance of 2.35 km was walked within the plantation and 5 birds were detected. All birds were flushed from within a maximum distance of 3.9 metres to the transect line. Beyond this distance no birds were detected.

A simpler alternative method to distance sampling, the fixed-width strip method can also be used to calculate densities from transects. It negates the use of detection curves and probability models by assuming a 100% detection rate within the width of the strip. The drawback being that it is likely to produce an underestimate. The half-width of the strip is determined by the distance of the furthest bird detected.

The detection limit of 3.9 metres creates a strip width of 7.8 metres. Multiplying this by the distance of the transect line 2.35 km gives an estimated area of coverage of 18,330 sq. metres, which equated to 11% of the total area of the plantation. With 5 birds recorded, this suggests a potential 45 birds using the plantation.

This does seem a rather high figure and it must be repeated that this is a very small data set. For example, it may well have been that birds would have flushed from a greater distance but none at this particular distance were encountered. This would have increased the width of strip and lowered the estimated figure.

Having said that, the plantation is ideally placed for Sunnyside Farm, The Moors and Hartland Stud, areas that between them were estimated to contain 115 birds and areas that have been proved by dusk flight observations to be used by birds roosting in this plantation.

It may well be that recent felling of the plantation, although clearly causing the eviction of some birds, could have concentrated the remaining birds into a higher density.

The transect line also passed through 1.86km of recently cleared areas, where there was some regrowth of shrub strata. Only one bird was flushed from this habitat flushing noticeably earlier at 8 metres distance.

A distance of 1.3 km was walked through a central area of Newton Heath plantation. This part of the plantation contained a shrub strata of tall dense bracken and irregularly scattered areas of rhododendron. Five birds were recorded within a maximum distance of 5.9 metres from the transect line.
Again assessing actual numbers is speculative but, using the same calculation techniques as above, the densities suggested were slightly higher than Slepe plantation.

The western most part of Wytch heath plantation which backs onto open pasture to the west (directly south of the oil gathering station) was traversed . A distance of 1.235km was covered with one bird detected (4m distance). Recent thinning has occurred here.
The transect was continued into the eastern part of the plantation on the opposite side of the service road. A distance of 2.16 km was covered taking in most of the rest of Wytch Heath plantation and encountering a varied shrub strata including areas of gorse. Three birds were recorded. Distances from the transect line were 2.3, 3.5 and 8 metres.

A 2.49 km transect through an area of Rempstone Heath, backing onto fields south of the Fitzworth peninsula, recorded no birds. This was rather surprising given the proximity of the wet grazed permanent pasture, which during spot-lamping was found to contain at least 12 birds.

A similar distance was zig-zagged through the conifer plantation directly east of The Moors and south of Arne Heath. No birds were recorded. This plantation backs directly onto The Moors which had the fourth highest feeding density of the survey. There was evidence of recent felling here.

Although woodcock are generally acknowledged to seek out cover when roosting, birds found at Slepe plantation were happy to roost on bare ground with little or no cover, relying completely on their camouflage. These birds were always close to a tree trunk.

Flushing distances were interesting, with birds roosting in areas of sparse or no cover flushing later and closer than birds within quite dense cover.

7.2. Other habitats

A 1.4km transect across a *Calluna* dominated area of Studland Heath adjacent to Greenlands Farm produced no roosting birds.
A 900 metre transect across Stoborough Heath bordering some of the most densely populated feeding areas of the harbour at Sunnyside produced no roosting birds as was the case with the strip of adjacent woodland to the west of Stoborough Heath.

Transects through deciduous woodlands were also undertaken at four separate sites with no birds being encountered. The main wood immediately south of The Moors on the Arne road was covered particularly thoroughly as birds were known to be present, being observed

leaving during dusk flight observations. During such observations on more than one occasion birds had sat tight just a couple of metres away from the observer until dusk before departing.

It must be assumed therefore that birds sit particularly tight in this habitat and transects are of limited value.

Previous data on such habitats has only been achieved from shoots where birds have been seen to leave, or from radio-tagged birds which have been pin-pointed.

8. Discussion

The most important areas in terms of numbers and feeding densities were fields west of Stoborough Heath at Sunnyside and fields to the south of Middlebere Heath. Both areas had estimated densities of 72 birds per sq. km. Sandwiched between was Hartland which recorded the next highest density of 60 birds per sq. km.

Other important areas were The Moors, fields north of the river at Frome Valley, and Middlebere

The floodplain grazing area of Frome Valley east (Bestwall and Wareham Water Meadows) could not be surveyed due to flooding but it seems likely that this area would also have proved to be important during non-flood conditions.

Presumably coincidences are at work here, however using isorithms connecting areas of broadly equal population densities, a rather interesting pattern appears. Density values in very broad terms radiate out from a core area, gradually diminishing in value to the north east and to the east, culminating an absence of birds in the far north east at Holes Bay and to the far east at Studland.

Not all sectors conform but there is a broad negative correlation between density and distance from the core area.

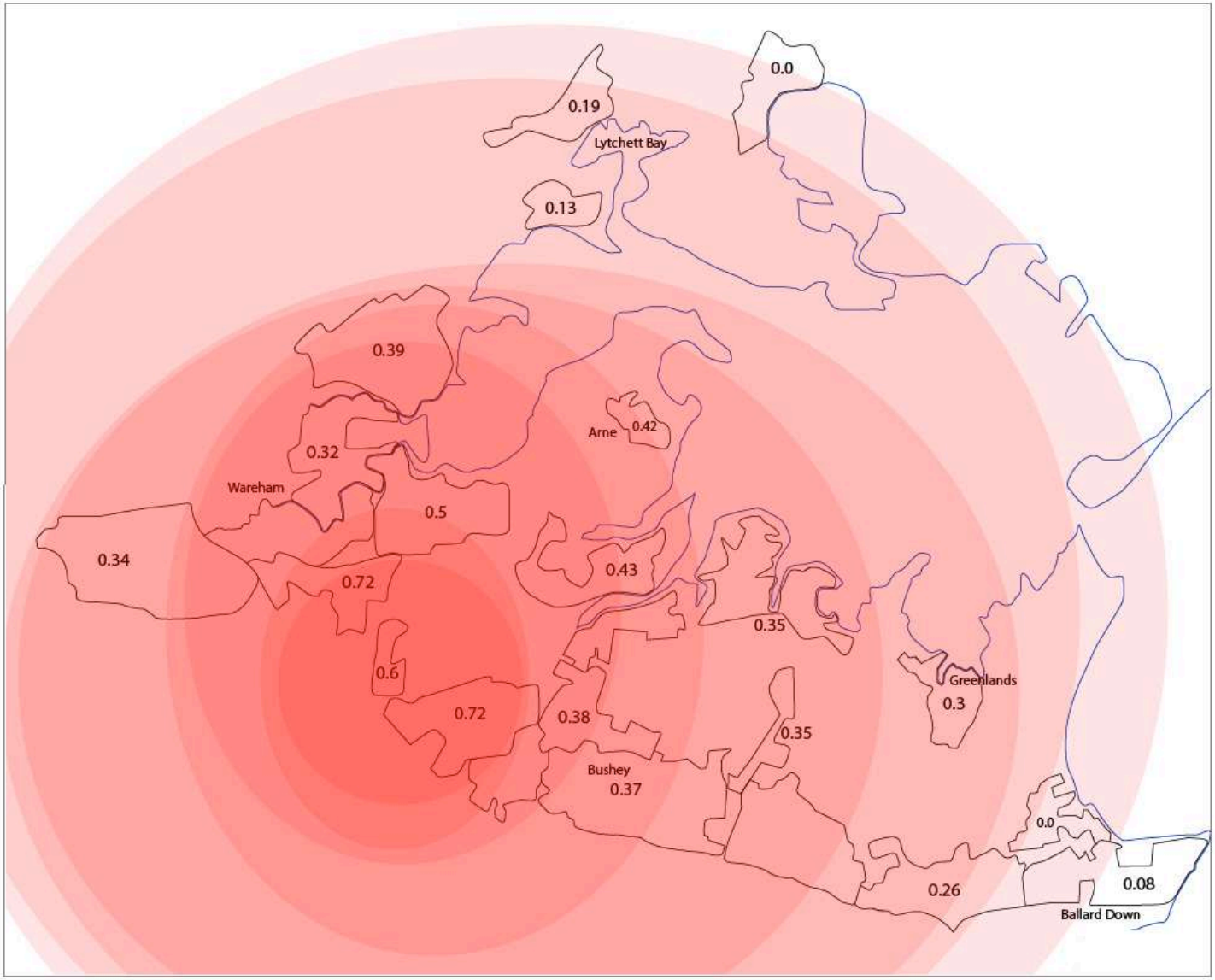

Fig 24. Density relationships between sectors using isorithms (darkest areas most densely populated)

In terms of habitat type, wet grazed permanent pasture was the most important, recording 76 birds per sq km. Small areas of Coastal and floodplain grazing were also available for feeding and recorded an almost identical 75 birds per sq. km. The similarity is not totally unexpected, given the similarity of the two habitat types during times of heavy rainfall.

Studies have shown that earthworm biomass is the most important factor affecting woodcock feeding numbers, the highest of which are to be found in saturated grazed permanent pasture. The presence of livestock keeps the grass short and softens up the ground allowing easier probing.

The least favoured habitat type that recorded birds was 'dry' ungrazed permanent pasture with characteristically long grass.
This is thought to be due to the difference in sward structure with the short swards of grazed pasture enabling easy circulation and better detection of prey and predators. Harder, drier mud also makes probing more difficult and contains less earthworms.

In between, in terms of preference were ley fields and arable fields. Both of these habitat types have a lower earthworm biomass than permanent pasture, thought to be caused by the regular ploughing. Previous surveys have shown that permanent pasture can contain up to 5 times the biomass of earthworms than arable fields. (Duriez 2004)

As demonstrated, feeding densities for any given habitat could vary between different parts of the harbour, indicating that factors other than habitat type were influential. Assessing these variables was beyond the scope of this survey however factors such as variation in saturation levels, proximity of suitable roost sites, local differences in earthworm biomass, levels of disturbance human or otherwise, predator abundance or perhaps proximity to more attractive feeding areas could all potentially have an effect on numbers.

At Middlebere and Bushey, PPG fields returned a higher density of birds than PPGW. As with other areas, exceptionally high rainfall resulted in many of the usually 'dry' fields being waterlogged to the extent normally reserved for 'wet' fields. This, combined with the possible over-saturation of some of the 'wet' fields, could have been the cause for the change in the usual distribution.

8.1. How do the density figures compare to other UK surveys?

It is generally agreed that the southern and western areas of England and Wales hold the highest UK numbers of wintering woodcock. (Tapper & Hirons 1983)

Cornwall, with its mild climate and predominance of dairy farms, is regarded as having the highest numbers of all and as such was the focus of much of the studies carried out by (Hirons & Linsley 1989 and Hoodless 1994). It is therefore to these studies that we look to compare.

Hoodless (1994) over 5 successive winters used spot-lamping to determine densities in Cornwall, Wiltshire, Derbyshire and Co. Durham. Most of the fieldwork being conducted at 3 pasture-dominated sites on the Lizard peninsula, Cornwall, which recorded by far the highest densities.

The highest average density recorded at any one site during that survey was just over 70 birds per sq. km at Lanarth Cornwall in 1989/1990, which was regarded as exceptional. Densities in fact varied quite considerably between years and sites.

During this survey, although area boundaries were arbitrary, both Sunnyside & Stoborough (a similarly sized survey area to Lanarth) and Gallows & New Mills Heath (around double the size) were estimated to contain 72 birds per sq. km.

Whether these figures are exceptional cannot be known from this baseline survey. As to how typical they may be is discussed in the next section.

Figures can also be compared based on habitat type. In (Hoodless 1994), although habitats were classified in terms of permanent pasture, ley grass and arable, no distinction was made between grazed, ungrazed, 'wet' or 'dry' pasture as all the fields were independently measured in terms of grass height, moisture levels, soil penetrability and earthworm and invertebrate biomass densities. (It was a thesis for a PhD) and consequently data was not presented in the same terms, however it is possible to make certain assumptions.
(Hoodless 1994) concluded that permanent pasture consistently contained the highest densities of birds. Lanarth for example where the highest densities were found, was dominated by permanent pasture.
Although mean density figures for the 5 year study were not published, in a later paper for British Birds Hoodless stated that densities "often reach 30 birds per sq. km in Cornwall". One can therefore assume these would have been areas of permanent pasture.

(Hirons & Linsley 1989) also conducted density estimates on the permanent pasture dominated areas of the Lizard peninsula using a combination of data from attending shoots and spot-lamping. Their estimated figures for the winter 89/90 from three different methods were 23.8, 34.4 and 40.9 birds per sq.km at a particular site where all three methods of calculation were possible. The latter two figures were considered to be the most accurate.

The density recorded for permanent pasture during this survey was 43 birds per sq.km

Only a small area of arable fields were able to be covered during this survey but the density of 12 birds per sq. km found and the 8 birds per sq. km estimated for the fields at Ballard Down matches exactly densities of 8-12 bird per sq. km proposed in (Hoodless 1995) for the largely arable areas of central and southern England.

To put some of these figures in perspective, (Hoodless 1994) recorded densities of 9 birds per sq. km for Wiltshire and 6 birds per sq. km for Co. Durham. (Hirons & Linsley 1989) recorded densities of just 4.3 birds per sq. km for Norfolk, and 3.5 birds per sq. km for Derbyshire.

The third of the three surveys referred to in section 3 determining methods, (Summers & Buckland 1996) recorded a density of 4 birds per sq. km within the native pinewoods of the Highlands.

8.2. Could some of the density figures have been higher than 'usual'?

Although this is the first study of its kind in Poole harbour, one can speculate as to how typical the density figures may have been.

As with the *Breeding Season Survey of Water Rails in Poole Harbour* (Hopper 2013) we find ourselves having to discuss the likely effects of the exceptional weather conditions. Last time it was low temperatures this time it is rainfall, (and rather mild temperatures)
For this survey, Poole Harbour along with the rest of Britain experienced one of its wettest ever winters resulting in many flooded areas.

Although a higher percentage at the beginning of the survey, just under 15% of the total potential feeding area in the harbour was still under water at the end of the survey. The majority being Coastal and Floodplain grazing, areas of which have now been proved to be attractive to feeding woodcock. It seems likely that areas adjacent to these flooded areas, such as Sunnyside and Hartland, received displaced birds resulting in higher 'than usual' densities.

Although woodcock travel large distances to spend the winter here and will not hesitate to move distances during widespread freezing conditions, it seems that in non freezing conditions they are somewhat less than adventurous once arrived at their chosen wintering area, with home ranges small compared to most other wintering waders (9 - 22 ha recorded by Hirons and Bickford-Smith 1983).

Spatial use studies in western France (Duriez *et al* 2005) have also shown that birds feeding in less favourable areas will use alternative sites on average under 400 metres away, with very small numbers searching beyond 1km distance.

It would seem likely therefore that the nearest alternative suitable feeding areas would have be sought, areas such as Sunnyside and Hartland.

Although solitary, both in terms of roosting and feeding, woodcock are known not to be territorial in winter and will happily tolerate their conspecifics. Many birds were seen feeding in very close proximity to each other during this survey.

As well as flooding out attractive feeding areas, the high rainfall also saturated areas of 'dry' permanent pasture PPG (no evidence of aquatic plants) making many of these areas as attractive as wet permanent pasture and in some cases more attractive as the wet areas became over saturated.
Thus for Middlebere, Bushey, Norden and Burnbake & Claywell PPG areas returned a higher density of feeding birds than PPGW.

As the survey progressed, water levels did gradually fall allowing areas previously flooded to be lamped toward the end of the survey. The Moors just prior to lamping had been completely inundated for quite some time and had only recently become exposed again. It is believed that during periods of extensive flooding, earthworms and other invertebrates are lost and recolonisation is slow. It is conceivable therefore that many of these areas, although exposed, may have contained lower than usual earthworm densities resulting in a possible lower than 'usual' density of feeding woodcock within this particular area.

Although some of the local density figures may have been higher than 'usual', it is likely that the overall population was lower than it would have otherwise been, with flooded areas near to the Poole Harbour recording boundary experiencing some emigration. Lytchett Bay, for example, where a short hop over the dual carriageway to some adjacent unflooded fields would have taken them out of the recording area.

8.3. Was it a 'normal' woodcock year?

It wasn't just 'local' weather conditions that were untypical. The winter was also particularly mild, both here and on the continent.
It is known that woodcock are temperature-sensitive birds, generally leaving the continent with the first onset of frost. Although renowned for being very site-faithful, often returning to the same wintering sites year on year, if the weather stays mild the incentive to perform long distance migration is lessened.

Data from this winter from the Game and Wildlife Conservation Trust suggests that wintering densities in Cornwall were about 80% of the average density "likely to be explained by the milder weather this winter" (GWCT blog 2014)

Data back from 8 GWCT satellite tagged birds from the Woodcock Watch project found that 3 birds spent the winter further east than their original capture site. With one only getting as far west as the Netherlands. This seems to have been met with some genuine surprise given the amount of data that has proved time and again wintering woodcock site fidelity.

Making such assumptions for Poole Harbour is of course speculative. Less birds may have got as far as Poole Harbour but conversely, some birds originally destined for Cornwall may have decided to remain in Poole?.....

8.4. Could the population estimate be an underestimate?

As discussed in section 4, a lot of attention was given to the designing of methods that best mitigated the potential issue of double counting so as not to produce an over estimate of numbers
There were however, also opportunities to miss birds. The most obvious being hidden or even hiding birds. A bird could be feeding behind a tussock and sit tight, or indeed be roosting. It is known that during the night woodcock will have roosting periods to digest food, very often discretely hidden behind a tussock.
They will also hide. During the survey although most birds either sat tight or flushed, a few birds discretely 'shuffled' out of view in a kind of crouched walk, most commonly toward a nearby tussock. A few however 'shuffled' not inconsiderable distances across open ground toward the nearest boundary hedge.
It has also been shown that some birds leave the fields and fly to adjacent areas such as moorland to roost a while before returning later to feed. (Hirons and Bickford Smith 1983)

Another source of potentially undetected birds were those flushed and not seen by being either side or further in front of the throw of the spot-lamp beam.

There was however a potentially higher impacting source of non detection. (Hoodless 1994) showed from radio-tagged birds that on average 7% of birds failed to leave their diurnal cover each night (9 from 124 bird-nights). His density calculations were corrected for this.

Braña *et al* (2010) also noted the same percentage with 1 bird in 14 (7%) failing to leave its chosen wood at dusk.

Duriez *et a*l (2005) found that between 10 and 25% of birds did not leave the woodlands at night and 14.7% of birds never visited fields, staying within the confines of the roost areas to feed. It was assumed that adequate feeding was had within these areas, with percentages of birds staying to feed within the roosting area increasing with average temperatures.
Given the very mild winter during this survey one could postulate that at least a similar percentage of Poole harbour's birds remained at their roost sites to feed. If just 7% of Poole harbour's birds decided to remain within their roost areas at night, the total estimated population would rise to nearly 700 birds.

9. Conclusions

With its combination of grazed permanent pasture, coastal & floodplain grazing, mild winters and apparent suitable roosting sites, Poole Harbour is clearly attractive to wintering woodcock and should be regarded as an important area.

The importance of its grazed permanent pasture and floodplain grazing has been established. Highest numbers of roosting birds were found within the conifer plantations during the limited pilot surveys but their value was not established. It is therefore not possible to speculate as to what impact the current programme of deforestation will have on the attractiveness of the area for woodcock.

Studies suggest that woodcock place much more importance on feeding areas and will accommodate a change in roost site to remain near their chosen feeding area (Ferrand *et al* 2013).

One can hope that alternative roosting sites in Poole Harbour will be sought from displaced birds.

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