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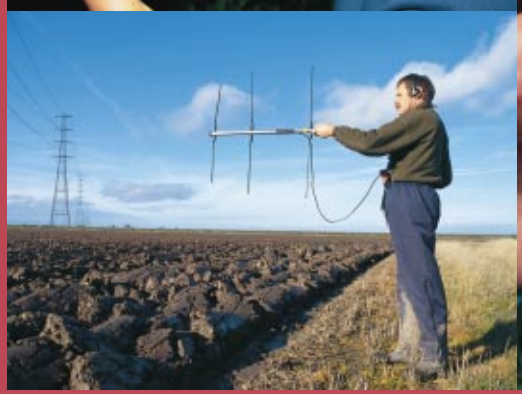

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Urban development adjacent to heathland sites in Dorset: the effect on the density and settlement patterns of Annex 1 bird species

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Abbreviations

ITE	Institute of Terrestrial Ecology
CEH	Centre for Ecology and Hydrology
EN	English Nature
RSPB	Royal Society for the Protection of Birds
SPA	Special Protection Area
CBC	Common Bird Census
BTO	British Trust for Ornithology

Abstract

The impact of urban development adjacent to heathland sites has long been of concern to conservationists. This concern stems from a wide variety of potential detrimental effects that may affect the conservation interest of a site. These include fragmentation, increased fire risk, disturbance from increased recreational use, pollution, predation from domestic pets and changes to the hydrology of a site.

This report first examines the relationship between the amount of urban development, adjacent to heathland sites in Dorset, and the numbers of three Annex 1 bird species (nightjar, woodlark and Dartford warbler). A simple approach is used to identify any relationships between the numbers and density of each species on a site and the degree of development surrounding that site. Individual sites (referred to as patches) and their heathland area were defined using the survey of Dorset Heathland conducted by ITE in 1996. All patches greater than 10 ha were included, and for each patch, the area of developed land within 500m of the patch boundary was calculated using aerial photographs. Bird data was collated for each patch from RSPB and other surveys during the 1990s. Bird density for each patch was calculated as bird numbers divided by heathland area.

A clear relationship was identified between the numbers of nightjars and the degree of development surrounding the heathland patch, with patches surrounded by a high degree of developed land supporting fewer nightjars. No such trend was demonstrated for woodlark or Dartford warbler. Patches were also categorised according to whether public access was restricted within part of the site or not. No significant effect of restricting public access on either nightjar or Dartford warbler density was found. However, there was a significant effect for woodlarks, with more woodlarks occurring on those patches, such as MOD sites, where public access is restricted.

A more detailed analysis was conducted for nightjars, comparing the location of nightjar territory centres with random points. The location of nightjar territory centres was found to be significantly different, when compared to the location of random points, in being further away from the nearest house and with fewer paths within one hundred metres.

The results are discussed in relation to the ecology of the species concerned and in the light of recent studies of the species concerned.

Introduction

The reduction in area and the fragmentation of Dorset's Heathlands has been well documented (Haskins 1978; Webb & Haskins 1980). In the east of the county, urban development has been the prime cause in the reduction in area (Haskins 2000). Besides isolating the fragments of heathland, there are a wide variety of factors associated with urban development, which may have a detrimental impact on the conservation interest of a site. These are reviewed in Haskins (2000) and include disruption to the hydrology of a site, pollution, increased fire risk, predation from cats and dogs, disturbance and trampling from increased public access.

As Haskins (2000) highlights, our understanding of how these effects may impact on birds of conservation concern on heathlands is often limited, and each factor in itself warrants intensive research. For example, the impact of human disturbance is one issue that is of particular current interest. The passage of the Countryside and Rights of Way Act in November 2000 focused attention on the need for more research addressing the relationship between access to the countryside and bird conservation (Liley 2001). The effects of human disturbance to birds have been reviewed by a number of authors (see Sidaway 1990; Hockin *et al* 1992; Carney & Syderman 1999; Nisbet 2000) and disturbance has been shown to reduce population size in some species (Liley 1999). However, very few studies have focused on heathland bird species and our knowledge of the impact of disturbance on heathland species is largely anecdotal. Hence the recommendation for further research to be targeted on heathland birds (Liley 2001).

The Dorset Heathlands provide an ideal potential case study on the impacts of urban development on key heathland species. Dorset holds 7373 ha of heathland, split into 151 different fragments, referred to as heathland patches (Rose *et al* 2000), which have been mapped and the areas of heathland vegetation determined for each fragment (Chapman *et al 19*89; Rose *et al* 2000). These patches occur both adjacent to and within the large conurbations of Bournemouth and Poole, while the heathland patches to the west of Poole Harbour are often far from any urban development. The Dorset Heathlands also support important numbers of three Annex 1 bird species (Table 1), therefore providing an ideal data set by which to attempt to determine the impact of urban development on the numbers of birds of conservation concern.

Table 1: Population estimates of Annex 1 (EU Directive on the conservation of wild birds, 79/409/EEC) bird species breeding on the Dorset Heathlands SPA (from SPA register entry, October 1998).

Species		**Recent population estimate for Dorset SPA**	**Percentage of national population**	**Year of survey**
Nightjar	*Caprimulgus europaeus*	436 + pairs	12.8 %	1992
Woodlark	*Lullula arborea*	41 – 56 pairs	9.3 %	1992
Dartford warbler	*Sylvia undata*	418 – 606 pairs	37.9 %	1994

The main aim of this report is to use the heathland patches to determine whether urban development around a heathland site has any effect on the numbers of birds on that site. Urban development is calculated using aerial photographs to calculate the area of developed land within 500m of each heathland site. Such a technique has been used before, for example by Kirby & Tantram (1999), who found a clear correlation between degree of development and the number of fires recorded for that heathland.

Methods

Heathland Distribution

Heathland data were obtained from the survey of the Dorset heaths conducted in 1996 by the ITE. This survey, and its predecessors, have provided the baseline data on the distribution and vegetational change occurring on the heathlands in Dorset (see Webb & Haskins 1980; Chapman *et al* 1989; Webb & Vermaat 1990; Rose *et al* 2000) and have been used to examine the distribution of birds within the Dorset Heaths (Van den Berg *et al* 2001).

The survey was based on a recording unit of a 200 x 200m grid square based on the Ordnance Survey National Grid. All such squares containing heathland-associated vegetation within Dorset were surveyed. Contiguous squares were grouped as patches. Two squares were defined as being contiguous when they were in contact along their sides (laterally) or at any of their corners (diagonally) and the percentage cover of heathland vegetation in at least one of the two squares exceeded 75%. Thus the boundary of such patches represent edges of heathland vegetation, rather than being determined by any site designations or land ownership. Only patches greater than 10 ha in total were included in this report analysis. For exact detail of all methods, see Chapman *et al* (1989), Rose *et al* (2000) and Van den Berg (2001).

Degree of developed land surrounding each heathland patch

The individual patches were taken as the basic sampling unit for analysis. Small patches less than 10 ha were ignored (none were surveyed for birds). For all 51 patches greater than 10 ha, the boundaries were drawn using MapInfo (Version 6), at a zoom level of 3 km, and over a base map of the 1:50 000 Ordnance Survey. For each patch a 500 m wide strip was drawn round the outside of the site, and then using orthorectified aerial photographs of Dorset (taken in 1997) as a base layer, the urban area within each 500 m strip was measured. This urban area was calculated by drawing polygons around all developed areas at a zoom level of 3 km. Developed areas included all buildings, warehouses and main roads. All patches used in the analysis, along with the urban areas within 500 m, are shown in Figure 1 and the data is summarised in Appendix 1.

For each heathland patch therefore, the following figures were calculated:

- area of land within 500m of the patch edge
- area of developed land within the above 500m width zone
- % of 500m band comprising developed land

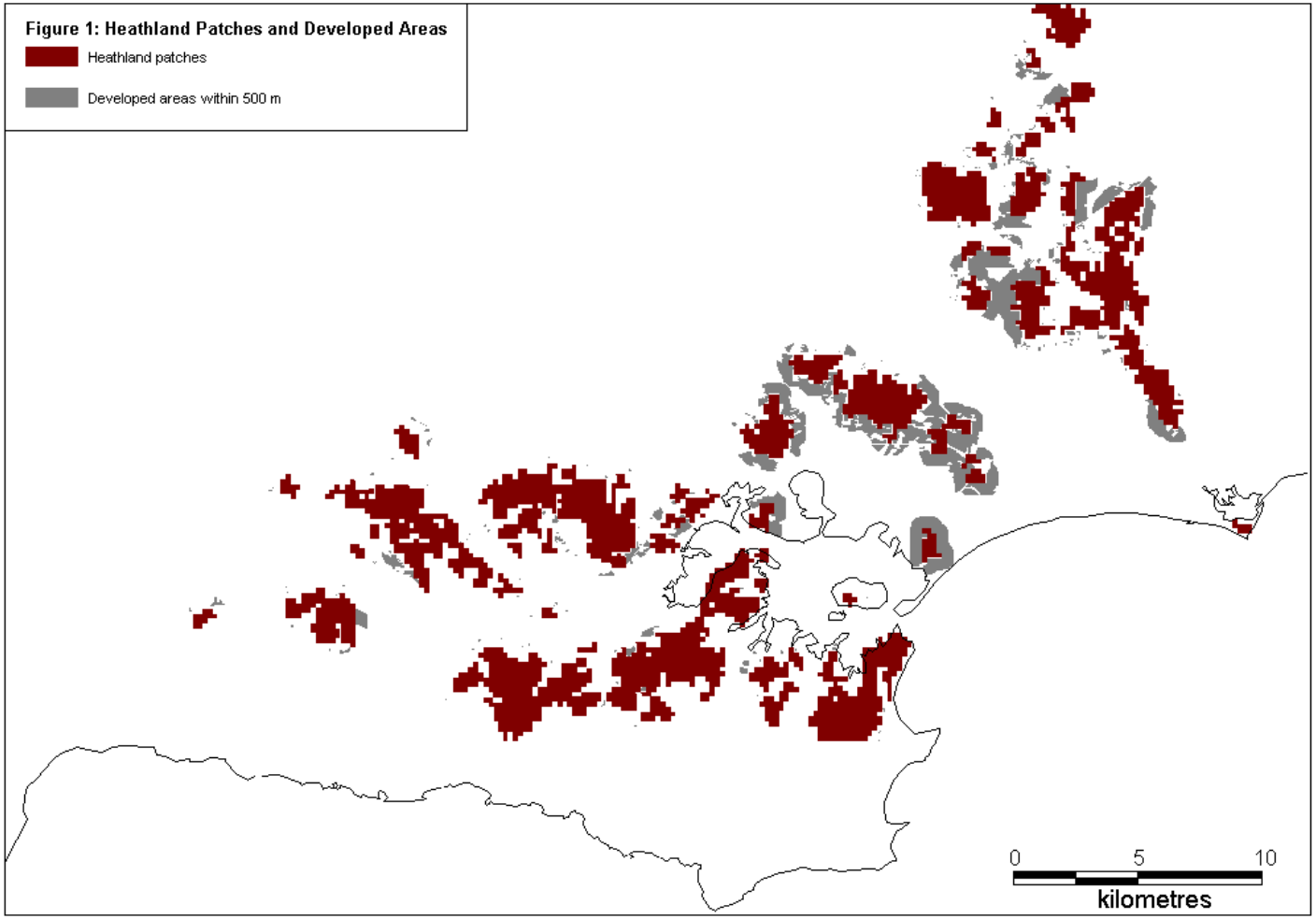


Figure 1: Heathland Patches and Developed Areas
Heathland patches
Developed areas within 500 m
0
5
10
kilometres

Bird data

The numbers of three key Annex 1 species (nightjar, woodlark, Dartford warbler) within each patch were collated from a number of sources. These included the RSPB Dorset Heathland Project, which has conducted bird surveys across Dorset since 1990; reserve managers; and the RSPB / BTO data collected as part of the national surveys conducted for each of the target species (in 1992, 1994 and 1997 respectively). All bird records were from CBC-type surveys, conducted over the whole of the patch in a given calendar year. Only surveys between 1991 and 2001 were used. Bird data were not available for all sites, in most cases because the areas surveyed did not match the ITE patch boundaries. All patches where the whole site had been surveyed in a given year for a species were included, and the number of sites differed between species (44 patches for woodlark, 36 patches for nightjar and Dartford warbler). In most patches the bird counts for each species were all taken from the year of their most widespread survey, namely 1992 for nightjar, 1994 for Dartford warblers and 1997 for woodlark; but where unavailable, other years' counts were occasionally used where considered representative.

The bird data are summarised in Appendix 2.

Detailed analysis of nightjar territory locations

In order to gain a more detailed insight into the distribution of nightjar territories on heathland sites, a separate analysis was conducted, comparing the location of nightjar territories with random points. Nine sites were selected, representing a range of different degrees of surrounding development. Nightjar territory centres were plotted from recent surveys by the RSPB Dorset Heathland Project (unpublished data). The surveys involved a minimum of two, pre-dawn visits, recording all nightjar activity at a site. Territories were then identified using the standard CBC type methodology (Bibby *et al* 1992). The centre of each territory was plotted, again using MapInfo, on aerial photographs. The following sites were selected to give a representation of parts of heaths with an urban fringe and public access. For each site the survey selected involved the most recent survey by the Heathland Project on the relevant site:

Ferndown
Black Hill (Bere Regis)
Parley Common
Sopley Common
Town Common
Upton Heath
Great Ovens
Stephen's Castle
Avon Heath Country Park (north)

Within each site, random points were plotted, using the same number of random points as the number of territories identified for the same site. At each point (nightjar territory centres and random points) the following variables were recorded using 1997 aerial photographs at a zoom level of 2000 m:

- Distance to the nearest edge of the site
- Distance to the nearest house
- Distance to the nearest road
- Number of paths within a 100 m radius of the point

Statistical Analysis

Density of each of the Annex 1 bird species, per patch, was calculated as the number of birds divided by the area of heathland vegetation within the patch. Density figures for each patch could then be correlated with the percentage of developed land within the 500m periphery.

Further analysis was conducted using multiple regressions of the (logarithm of) bird numbers per patch, and including the (logarithm of) area of heathland vegetation as one of the predictor variables. For some graphs, points were categorised according to the percentage of developed land within the 500m periphery. For this categorisation three categories were chosen, with the number of sites within each category approximately equal (<2 % developed: 16 sites; 2 – 20 % developed: 19 sites; >20 % developed: 15 sites).

The comparison of nightjar territory centres and random points was conducted by combining all sites, and directly comparing the two data sets using a non-parametric technique.

All analysis was conducted using MINITAB (Release 13 for Windows).

Results

There was a significant negative correlation between nightjar density and the percentage of developed land within 500m (Figure 2). No significant correlation was demonstrated for either woodlark (Figure 3) or Dartford warbler (Figure 4).

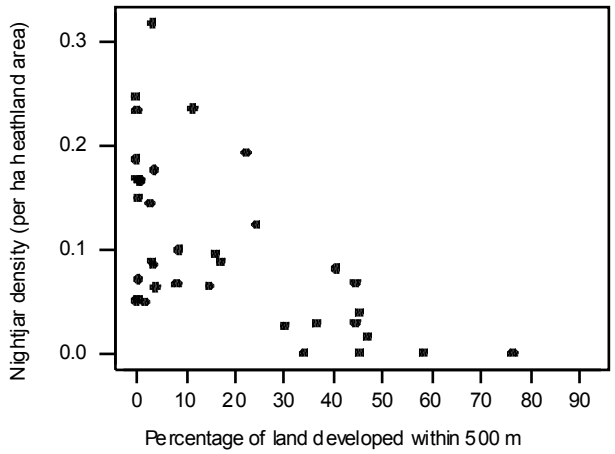


Figure 2: Correlation between nightjar density (per ha of heathland per patch) and the percentage of developed land within 500m. The correlation is significant: Pearson correlation coefficient = -0.61, p = <0.001, n = 36 patches.

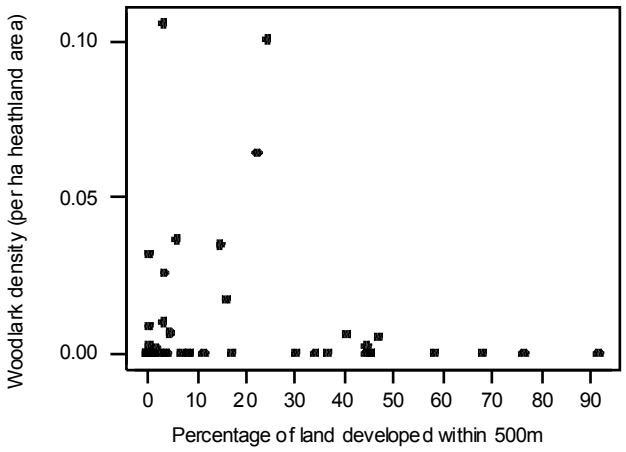


Figure 3: Correlation between woodlark density (per ha of heathland per patch) and the percentage of developed land within 500m. The correlation is not significant: Pearson correlation coefficient = -0.11, p = 0.49, n = 44 patches.

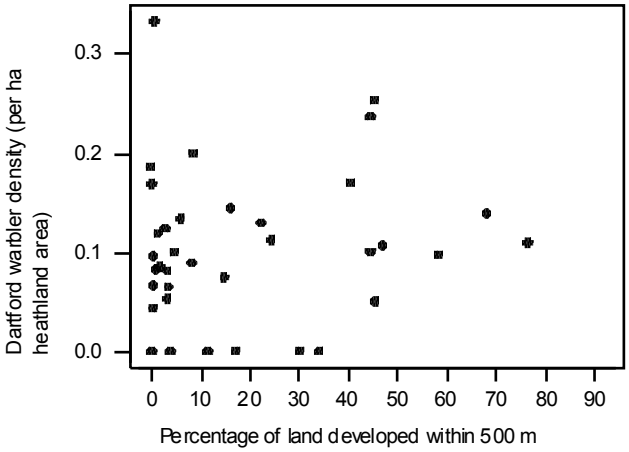


Figure 4: Correlation between Dartford warbler density (per ha of heathland per patch) and the percentage of developed land within 500m. The correlation is not significant: Pearson correlation coefficient = 0.11, p = 0.51, n = 36 sites.

The relationships shown above were further tested by using the numbers (rather than density) of each species per patch in a regression analysis. The number of birds on a patch might naturally be expected to increase with the size of the patch. The data suggest that, for each species, there is an approximately linear relationship between the logarithm of the number of birds on a patch and the logarithm of the area of heathland on the patch; all three relationships are statistically highly significant and heathland area is a very good predictor of the numbers of nightjar, woodlark and Dartford warbler found on a patch. (All logarithms to base 10, denoted log 10). These relationships are shown in Figures 5, 6 and 7, with sites categorised according to three levels of development in the surrounding 500m.

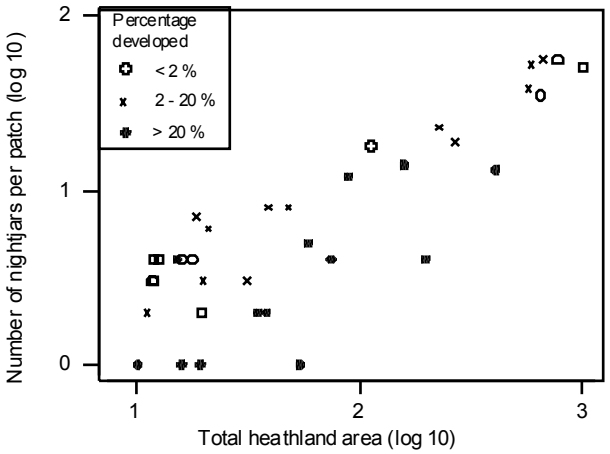


Figure 5: Relationship between number of nightjars per patch and total heathland area. A trendline is not illustrated in order not to obscure the different points, but the relationship is significant: log number of nightjar = - 0.46 + 0.71 log heathland area, r^2 = 72.0 %, n = 36, F = 91.04, p < 0.001.

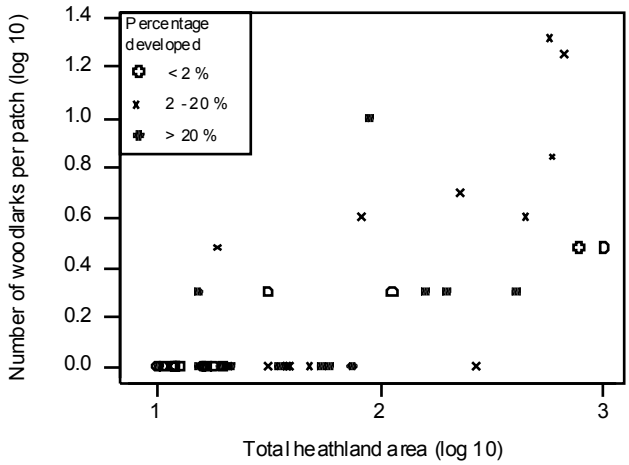


Figure 6: Relationship between number of woodlarks per patch and total heathland area. A trendline is not illustrated in order not to obscure the different points, but the relationship is significant: log number of woodlarks = - 0.49 + 0.42 log heathland area, r^2 = 49.7 %, n = 44, F = 43.57, p < 0.001.

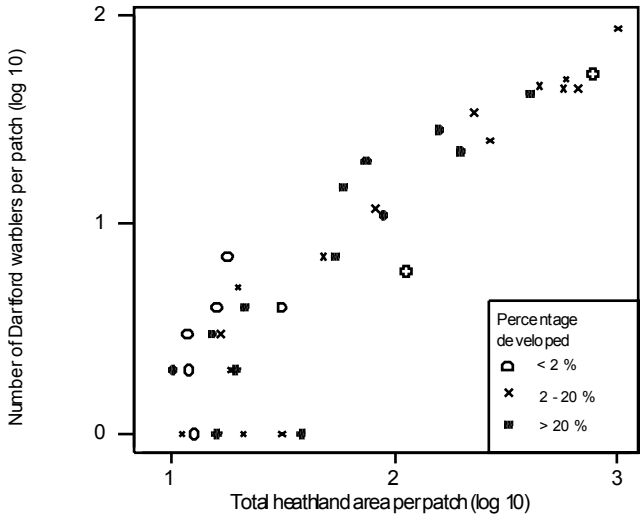


Figure 7: Relationship between number of Dartford warblers per patch and total heathland area. A trendline is not illustrated in order not to obscure the different points, but the relationship is significant: log number of Dartford warblers = - 0.72 + 0.88 log heathland area, r^2 = 82.2 %, n = 36, F = 163.07, p < 0.001.

It can be seen that for nightjar, the sites with a high percentage of developed land within 500m are generally to be below the other points in the graph, but show a similar increase with heathland area. This suggests that for any given size of site, those with a high percentage of urban development in their surrounding land are likely to have fewer nightjars. This relationship seems to hold for any size of patch up to at least 400 ha. of heathland (none of the few larger patches had over 20% urban surroundings with which to assess the relationship).

This relationship between the percentage of the 500m band that is developed and nightjar numbers can be tested statistically. Adding it as an additional variable in the multiple regression relating log numbers to log heathland area gives a statistically significant ($p < 0.001$) improvement in predictive ability. 90 % of the variation in numbers of nightjars per patch could be explained using the total area of heathland on the patch and the percentage of the 500m band that is developed (Table 2).

Table 2: Multiple regression results predicting the (log 10) numbers of nightjars within each patch using two variables, namely the total area of heathland within each patch and the percentage of developed land within 500m, $r^2 = 90.0$ %, n = 36 sites.

	Regression coefficient	**T value**	**p**
Constant	-0.24	-2.74	0.010
Area of heathland per patch (log 10)	0.70	15.69	< 0.001
Percentage of developed land within 500m.	-0.01	-7.91	< 0.001

For both woodlark and Dartford warbler numbers per patch there is no apparent visual (Figures 6 and 7) or statistically significant (both $p > 0.2$) relationship with the percentage of developed land within 500m of the patch.

The effect of public access to sites

A number of the patches included in the above analysis have public access restrictions on parts or all of the site. All sites were classified as to whether the public had appreciable access or not. The relationship between (log 10) bird numbers (per patch) and the (log 10) area of heathland per patch was tested with public access included as an additional variable. For nightjar and Dartford warbler numbers, public access was not significant when included in the multiple regression. However, the public access variable was a statistically significant ($p < 0.05$) predictor for woodlark numbers and the amount of variance explained increased from 50 % (Figure 6) to 55 % (Figure 8, Table 3).

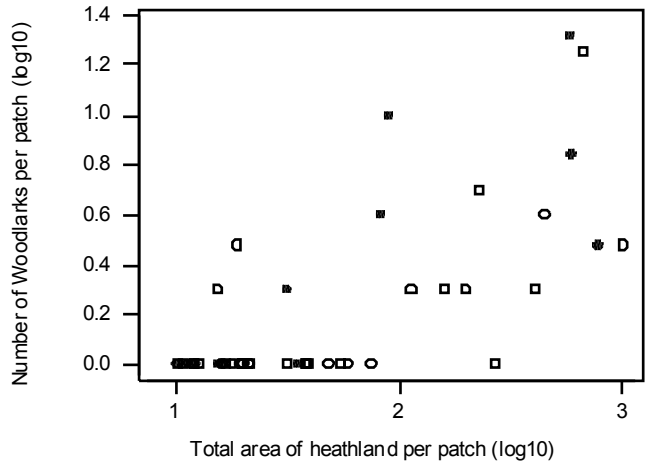


Figure 8: Number of woodlarks per patch for sites with public access restricted (filled circles: n = 12) and where public access is not restricted (open circles: n = 32).

Table 3: Multiple regression results predicting the numbers of woodlarks within each patch using two variables, namely the total area of heathland within each patch and whether or not public access is restricted or not, r^2 = 55.2 %, n = 44 sites.

	Regression coefficient	T value	p
Constant	-0.33	-2.67	0.011
Area of heathland per patch (log 10)	0.41	6.87	< 0.001
Public access to site restricted (1=yes, 0= no)	-0.20	-2.47	0.018

Locations of nightjar territory centres compared with random points

With points for all sites combined, there was no significant difference between nightjar territory centres and random points in the distance to the nearest edge of the site, nor the distance to the nearest road. However, nightjar territory centres were located significantly further away from houses than random points (Figure 9).

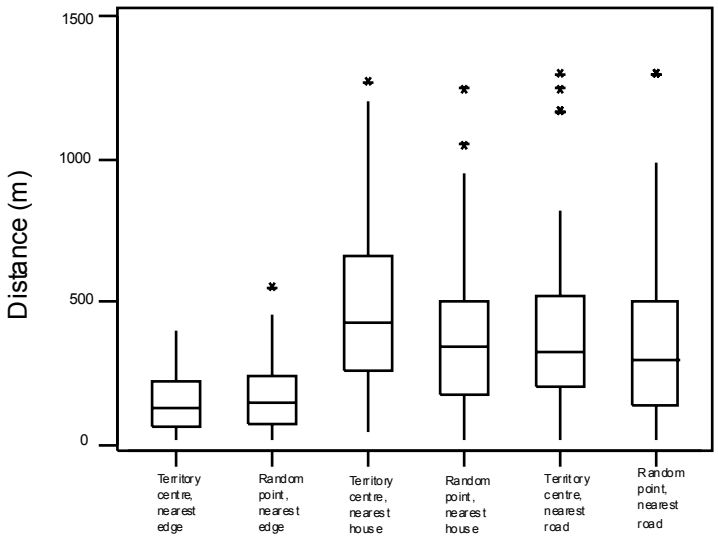


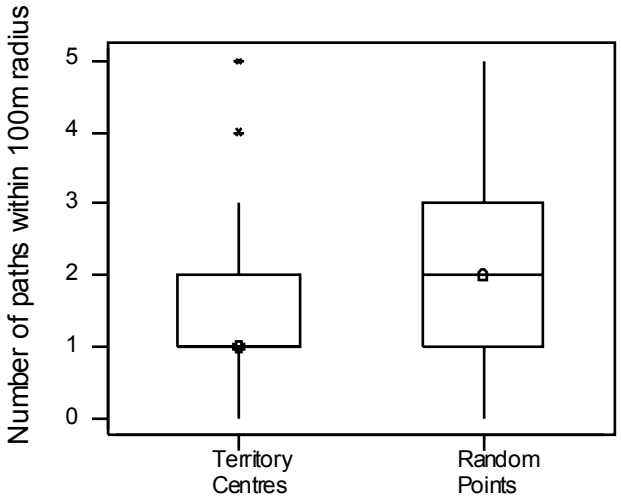
Figure 9: Box plots summarising the location of nightjar territory centres compared to random points (all sites, all points). Box = interquartile (25-75%) range, middle horizontal line = median, vertical line = rest of range except * which denote outlying points. The difference is significant only for the distance to the nearest house (Mann Whitney test statistics, n = 93 for each: distance to the edge of the site: W = 8348, p = 0.34; distance to the nearest road: W = 8980, p = 0.44; distance to the nearest house: W = 9574, p = 0.017).

Table 4 compares the distances for random points and nightjar territory centres by site, and it can be seen that, for eight out of the nine sites, the median distance to the nearest house was greater for nightjar territory centres than for random points.

Table 4: Comparison between the n actual nightjar territory centres (white columns) and n random points (grey columns), in the median distances to landmark features.

Site	Median distance (m) to nearest:						
	edge	edge	house	house	road	Road	n
Avon Heath north	150	120	335	180	470	235	12
Black Hill (Bere Regis)	90	160	1130	950	1170	990	5
Ferndown	125	120	520	345	530	400	2
Great Ovens, HCT	135	85	325	195	215	110	8
Parley	150	90	285	420	320	505	12
Sopley	40	140	590	390	215	155	10
Stephen's Castle	50	80	200	140	160	180	7
Town	190	190	460	290	330	290	24
Upton	140	190	450	420	470	450	13

Territory centres also differed from random points in the number of paths within one hundred metres (all points from all sites combined: Mann Whitney Test, W = 9970; p = 0.003). Nightjar territory centres had fewer paths within 100m than random points (Figure 10). The median number of paths was lower for nightjar territory centres than



random points on seven out of the nine sites and the same on one site (Table 5).

Figure 10: Box plot summarising the data describing the number of paths within 100 m of nightjar territory centres and random points, for all points from all sites. Box plot shows the interquartile range, median (horizontal line with an open circle in the centre) and outlying points (more than 1.5 times greater or less than the middle 50 % of data). The difference between the two groups is significant: W = 9970; p = 0.003).

Table 5: Median number of paths within 100m, for the n actual nightjar territory centres and n random points, on each site.

Site	Median number of paths within 100m		
	Nightjar Territory Centres	Random points	n
Avon Heath north	1	1.5	12
Blackhill	0	1	5
Ferndown	4	3.5	2
Great Ovens, HCT	0.5	2	8
Parley	2	2.5	12
Sopley	1	2.5	10
Stephen's Castle	2	2	7
Town	1	2	24
Upton	1	2	13

Discussion

The analysis presented here has used a simple data set to examine trends in bird numbers across the Dorset Heathlands. The amount of developed land round each heathland site has been used as a surrogate measure for a suite of factors associated with urbanisation. These factors, which include the levels of different human activities occurring on the site and the number of fires (Haskins 2000) may not be independent and as such, the index provides a good single measure for a number of correlating variables. It has been shown that people living close to heathland sites in Dorset do visit them on a regular basis (Atlantic Consultants 1996) and the high levels of access and recreational use of some Dorset heaths are shown by a variety of authors (Molenaar 1998; Norrington 1998; Haskins 2000). Sites with a given level of surrounding development may well vary in the levels of access because, for example, the area developed does not take into account the density of housing. However, given the number of patches included in this study the index is believed to be a good indicator of the degree of urban influences occurring at each site. Its effectiveness has been clearly shown in other studies (Kirby & Tantram 1999).

The results clearly demonstrate that the number of nightjars present on a heathland site is linked to the measure of urban development around the periphery of the site, with sites surrounded by a high amount of development supporting fewer nightjars. The reasons for this effect cannot be directly determined from such an analysis, but it is possible to infer likely causes. A feature of the nightjar's ecology is that they will often leave the nesting areas to feed, with studies in Dorset showing that radio-tagged birds travel an average of 3.1 km to feed (Alexander & Cresswell 1990). Such studies have shown nightjars to prefer to feed in semi-natural habitats (Alexander & Cresswell 1990; Sierro *et al.* 2001), and it is therefore possible that the trend shown within this report could result from a loss of suitable feeding areas, in particular deciduous woodland or orchards (Cresswell 1996, page 301).

Nightjars are also ground nesting species, with nest sites situated on open ground. Ground nesting species have been shown to be vulnerable to a range of disturbance effects, such as predation of eggs, or chicks, by dogs (Nol & Brooks 1982; Pienkowski 1984) and accidental trampling of nests by people (Liley 1999). The comparison between nightjar territory centres and random points does show that territory centres are located in areas with fewer footpaths and away from houses. This would suggest that there could be an effect of human activity on sites. Studies of other species have shown that birds will, during the breeding season, avoid areas with a high level of human activity (Schulz & Stock 1993; Liley 1999), or occur at lower densities in disturbed areas (Van der Zande *et al* 1984*)*.

By contrast to nightjars, this study does not demonstrate an effect of urban development on the numbers of either woodlarks or Dartford warblers. This does not necessarily indicate that an effect on their breeding ecology (for example a reduction in productivity) is not present. Woodlarks, unlike the other two species, are not restricted to heathland, and are known to breed in a variety of habitats, including farmland and conifer plantations (Sitters *et al* 1996; Wotton & Gillings 2000). They are associated with areas of bare ground or very short grass (Bowden 1990; Wotton & Gillings 2000), and the nest is on the ground, typically sited in tussocks of grass

(Cramp & Simmons 1977), often alongside paths and firebreaks (J Mallord, *pers comm*. unpublished doctoral research). As suitable habitat is likely to be patchily distributed, it might be expected that the relationship between the numbers of woodlarks on a given site and the area of heathland would be less strong than that of the other two species. Thus sites such as Arne or Hartland Moor, which contain large tracts of mature heather, support very few woodlarks. Hence, there is a large variation in the density of woodlarks, but as Figure 3 shows, this variation only occurs on sites with the least amount of surrounding development and no sites with a high degree of urban development support a high density of woodlarks. In order to predict more accurately the numbers of woodlarks on a site a better habitat measure than heathland area would be necessary.

A significant effect, however, was found for woodlarks when the public access variable was included in the regression. Sites were categorised as having restricted access when a major part of the patch had restricted public access, for example at Arne RSPB Reserve or MOD sites. The result should be viewed with caution due to the fact that some MOD sites contain good woodlark habitat, created by tank and vehicle driving, and hence this may explain the higher numbers of woodlarks. However, given woodlarks' preference for nesting on the ground, close to paths, and feeding in areas of open ground or short vegetation, where dogs are likely to be running freely, it might be expected that woodlarks are sensitive to disturbance. This is an area where more detailed research is required, ideally starting by identifying and mapping areas of suitable woodlark habitat.

Dartford warblers are perhaps the species for which an effect of disturbance is least expected. Unlike the other two species, the nest is located off the ground, and in dense vegetation, often in gorse (Bibby 1979) where people and dogs are less likely to venture. A second issue is that the population size is rapidly increasing. The population in 1994 had increased four-fold from the previous survey in 1984 (Gibbons & Wotton 1996) and this trend has continued since 1994, with areas such as Suffolk, where the species last bred about 80 years ago (Gibbons & Wotton 1994) being recolonised. Given such a population increase it is likely that even poor quality territories will be occupied.

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Appendix 1: Summary of Urban Data

Patch No.	Patch Name	Area of heathland (ha)	Area within 500m developed (ha)	Area of 500m band (ha)	% of 500m band developed	Public access (y = yes, to most of site)
9	*Warmwell*	31.64	9.65	241.53	4.00	y
17	*Southover heath*	10.85	0.74	241.94	0.31	y
18	*Winfrith Heath*	267.23	49.19	611.81	8.04	y
21	*Bovington*	585.68	44.68	1365.84	3.27	n
24	*Bovington Heath*	8.69	1.24	202.73	0.61	n
32	*Clouds Hill*	12.13	0	178.29	0	n
33	*Blackhill, BR*	48.23	8.06	293.45	2.75	y
35	*Povington and Grange*	768.46	3.29	1184.05	0.28	n
38	*Morden / Great Ovens*	655.23	50.28	1416.77	3.55	y
39	*Stokeford Heath*	31.18	1.02	276.71	0.37	n
40	*Stokeford II*	10.13	0	189.46	0	n
42	*Worgret Heath*	16.8	2.21	174.89	1.27	y
44	*Trigon / Cold Harbour*	18.81	7.52	230.16	3.27	y
47	*Stoborough Kings Barrow*	12.27	0	194.21	0	n
53	*Arne / Hartland / Stoborough*	989.98	31.05	1726.02	1.80	y
57	*Sandford Heath / Keysworth*	38.24	18.51	270.12	6.85	y
58	*Sandford Heath / Black Hill*	11.27	39.36	229.95	17.12	n
61	*Holton Heath*	82	26.27	437.39	6.01	n
69	*Upton Heath*	196.48	244.61	521.43	46.91	y
70	*Rempstone Heath*	39.4	13.29	350.09	3.80	y
71	*Rockley Sands*	35.01	105.93	289.33	36.61	n
74	*Shipstal, Arne*	11.87	0.22	190.57	0.11	y
75	*Gold Point, Arne*	16	0	189.41	0	n
76	*Rempstone / Bushey*	50.35	0.94	382.47	0.25	y
81	*Rempstone / Ower*	21.43	2.26	221.74	1.02	n
82	*Corfe Hills*	74.88	168.38	372.5	45.20	y
84	*Studland / Godlingston*	639.39	4.17	1095.05	0.38	y
91	*Canford*	407.17	338.66	760.22	44.55	y
95	*Brownsea*	12.78	0.27	186.06	0.15	y
103	*Luscombe Valley*	15.6	261.56	286.14	91.41	n
104	*Holt Heath*	446.94	27.23	594.99	4.58	y
105	*Turbary*	54.43	315.61	412.43	76.52	y
113	*Bourne Valley*	10.26	119.06	204.38	58.25	y
114	*Ferndown*	58.97	144.5	324.72	44.50	y
115	*Uddens*	16.05	77.49	227.69	34.03	y
118	*Bourne Valley, Ferne Barrow*	21.45	143.11	210.31	68.05	y
123	*Horton*	19.94	20.79	243.91	8.52	y
127	*Slop Bog*	19.67	97.41	214.27	45.46	y
128	*Horton II*	17.97	1	210.9	0.47	y
131	*Parley Common*	157.47	241.52	596.78	40.47	y
132	*West Moors Petroleum Dump*	88.84	98.21	403.99	24.31	n
133	*Lower Common*	21.15	30.21	261.68	11.54	y
136	*Stephen's Castle*	15.43	49.24	220.87	22.29	y

138	*Cranbourne Common*	113.6	1.86	548.2	0.34	y
139	*Three legged Cross*	12.04	1.61	206.17	0.78	y
141	*Ringwood Forest*	44.24	53.81	424.32	12.68	y
143	*Avon CP / Barnsfield & Hurn*	571.28	220.57	1482.83	14.87	n
144	*Lions Hill*	38.38	104.7	348.77	30.02	y
148	*Town / Sopley / St. Catherines*	227.54	117.86	728.68	16.17	y
151	Hengistbury Head	19.72	0	210.73	0	y

Appendix 2: Summary of Bird Data

Patch No.	Number of nightjar	Survey year for nightjar	Number of woodlark	Survey year for woodlark	Number of Dartford warblers	Survey year for Dartford warblers
9	2	1992	0	1997	0	1994
17	*	*	0	1997	*	*
18	18	1992	0	1997	24	1994
21	52	1992	6	1994	48	1994
24	*	*	*	*	*	*
32	3	1992	*	*	*	*
33	7	1992	0	1997	6	1994
35	55	1992	2	1994	51	1994
38	56	1992	17	1997	43	1994
39	*	*	1	1997	3	1994
40	*	*	0	1997	*	*
42	*	*	0	1997	2	1994
44	6	1992	2	1994	1	1994
47	*	*	0	1997	*	*
53	49	1992	2	1997	85	1994
57	*	*	0	1997	*	*
58	1	2000	0	1997	0	2000
61	*	*	3	1997	11	2000
69	3	1992	1	1997	21	1994
70	7	1992	0	1994	*	*
71	1	1991	0	1997	*	*
74	2	1992	0	1997	2	1994
75	3	1992	0	1997	3	1994
76	*	*	*	*	*	*
81	*	*	*	*	*	*
82	3	1992	0	1994	19	1994
84	34	1992	*	*	*	*
91	12	1992	1	1996	41	1994
95	3	1992	0	1997	0	1994
103	*	*	0	1997	*	*
104	*	*	3	1997	45	1994
105	0	1991	0	1997	6	1991
113	0	1991	0	1997	1	1994
114	4	1992	0	1997	14	1994
115	0	1991	0	1997	0	1994
118	*	*	0	1997	3	1994
123	2	1992	0	1997	4	1994
127	0	1991	0	1997	1	1994
128	3	1992	0	1997	6	1994
131	13	1996	1	1997	27	1994
132	11	1992	9	1997	10	1994
133	5	1992	0	1997	0	1994
136	3	1992	1	1994	2	1994
138	17	1992	1	1997	5	1994
139	2	1992	0	1994	1	1994
141	*	*	*	*	*	*
143	37	1992	20	1997	43	1994
144	1	1992	0	1997	0	1994
148	22	1992	4	1997	33	1994
151	1	1992	0	1997	*	*

Asterisks denote no available data.

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