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Foraging by Nightjars *Caprimulgus europaeus* away from their nesting areas

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Radio-tagged Nightjars *Caprimulgus europaeus* nesting in conifer plantation clearings and on lowland heath in Dorset travelled an average of 3·1 km away from their nesting areas at night to atypical habitats, presumably to feed. Comparison of habitat availability with use showed that Nightjars preferred deciduous or mixed woodland habitats, while they avoided conifer plantations and arable or improved grassland. Absence from the nesting area was recorded on 72% of bird-nights and birds were least likely to be away during the middle third of the night. The use of atypical habitats may have implications for Nightjar conservation.

The number of Nightjars *Caprimulgus europaeus* breeding in Britain has fallen this century (Stafford 1962, Sharrock 1976, Gribble 1981) and may still be declining. The causes most often suggested are climatic change (Gribble 1981, Berry & Bibby 1981) and destruction of breeding habitat by the development of heathland and commons for building, agriculture and commercial forestry (Stafford 1962, Sharrock 1976, Gribble 1981).

Breeding Nightjars are thought to be territorial (Cramp 1985) and to feed mainly near their nests after laying (Schlegel 1967). However, loose aggregations of birds have been reported around good feeding sites away from territories (Lack 1932, Berry 1979). Glutz von Blotzheim (1962) and Schlegel (1967) describe Nightjars foraging several kilometres from suitable nest areas prior to the laying period, often exploiting abundant resources in open areas, near herds of grazing animals, or near water. Despite these accounts, there has been no investigation of the extent of the Nightjar's dependence on habitats other than those in which it nests. Without this knowledge some causes of the Nightjar's decline could be overlooked and conservation measures may not be soundly based.

This study describes visits by radio-tagged Nightjars to habitats away from their nesting sites in conifer plantation clearings and on heathland in Dorset. We describe how much time the birds spent away, how far they travelled on foraging excursions and what habitats they visited.

Methods

Study areas

The work was carried out during the summers of 1985 and 1986. In 1985 Nightjars were caught in a cleared and replanted area of a conifer plantation in Wareham Forest, South Dorset. The clearing was about 40 hectares in extent, with 1–2 m high pines *Pinus* sp. among heathers *Calluna* and *Erica* spp., bracken *Pteridium aquilinum* and purple moor-grass *Molinia caerulea*. One radio-tagged female nested there, while several males sang and probably nested there also.

Two study sites were used in 1986; a second clearing in Wareham Forest and an area of heathland on Hartland Moor National Nature Reserve, South Dorset. The Wareham Forest clearing covered about 14 ha and had similar flora to the 1985 site. We knew of three concurrent Nightjar nests in this clearing in late June, and suspected that other pairs were nesting there too.

The Hartland site was lowland heath, comprising mainly heathers and purple moor-grass interspersed with clumps of gorse *Ulex* sp. and birch *Betula pendula* scrub. The study site was bounded to the west by a road and to the north by a mature pine plantation. The heathland extended several kilometres to the south and east.

Radio tracking

Adult Nightjars were caught in mist nets (Squire & Alexander 1981), ringed, and fitted with 2 g back-pack radio tags (from Biotrack) using a method devised for Snipe *Gallinago gallinago* (Green 1988). Each tag was fastened to an oval patch of fine cotton gauze, about 20 × 15 mm, which was glued with cyanoacrylate-based glue (Superglue) to the feathers on the back. We degreased the feathers with acetone before mounting the tag and avoided glueing directly to the bird's skin. The cell life of the tags was about 2 months but no tags stayed attached to a bird for this long.

In 1985, a car was used to follow three tagged males and one female on foraging flights away from their nesting grounds. One bird was chosen each evening but, if radio contact was lost or the bird became inactive, searches were made for other tagged birds which might have been using the same area. We aimed to spend an equal number of nights tracking each tagged bird, although the same bird was often tracked for three or four consecutive nights to see if it was visiting the same feeding sites.

Feeding sites were defined as places where a Nightjar spent more than 10 minutes and where its position was known to within 50 m. Site revisiting was recorded if a Nightjar spent more than 10 minutes within 50 m of a site it had visited on a previous night.

The mobile tracking team operated similarly in 1986 and an extra worker recorded which tagged birds were present on the nesting area at different times of night. The signals from all tags were checked every 15 minutes, using a Mariner M-57 Receiver and a Biotrack 5-element Yagi antenna mounted on a 3 m mast. In Wareham Forest the mast was positioned at the highest point in the clearing, from which there was a signal range of more than 800 m. Birds were recorded as absent if their radios could not be heard, in which case they were almost certainly outside the clearing.

At Hartland Heath, Nightjars were monitored from a small knoll next to the boundary road. They were recorded as absent if they were out of range or if they were west of the road. Signal range to a hand-held 5-element Yagi on the knoll was at least 500 m.

A total of 29 birds was tagged in 1986, with a maximum of six at any time at either site. Most tagged birds provided some data on absence from the nesting area but, because of a problem with premature tag detachment, data on foraging behaviour were provided by only 11 birds. These were 5 females and 4 males at Wareham Forest and 2 males at Hartland Heath.

Tracking alternated weekly between the two study sites. The weeks 16–22 June, 30 June–6 July and 14–20 July were spent at Wareham Forest and the periods 23–29 June, 7–13 July and 21–27 July at Hartland Heath. Most tracking of birds away from their nesting area was done between dusk and midnight. Data on absence from the nesting area were usually collected all night.

Survey of habitat availability

The habitats available to foraging Nightjars were assessed from an Ordnance Survey Map (1:25,000) by estimating the percentage by area of each habitat type in each of one hundred 1-km squares within a radius of 6 km from the Wareham Forest study sites. The proportion of each habitat in the whole area was then calculated and compared with the use of the habitat by the radio-tagged Nightjars breeding at Wareham Forest. Too few data were available from birds at Hartland Heath for the same comparison to be of any value. The habitat types defined were arable fields or improved grassland, deciduous or mixed woodland, conifer plantations (including clear-fell), wet heath, dry heath, riparian habitats or wet meadows (wetlands), rural gardens or orchards, urban or suburban areas.

Weather

Records of nightly temperature minima and maxima, rainfall and mean wind-speed, taken at a weather station 22 km east of the study sites, were supplied by the Meteorological Office. Moon phase, rise and set times were taken from a 1986 Almanac.

Results

Absence from the nesting areas

To determine when Nightjars were most often away from their nesting area, each night was divided into thirds (early, middle and late) between sunset and sunrise. The first and last searches of each night were excluded because these may have included birds which were at daytime roosts.

Most tagged Nightjars spent some time each night away from their nesting area. On 72% of the 47 complete bird-nights at Wareham Forest and on 75% of 12 nights at Hartland Heath there was at least one period of absence per bird-night. Mostly

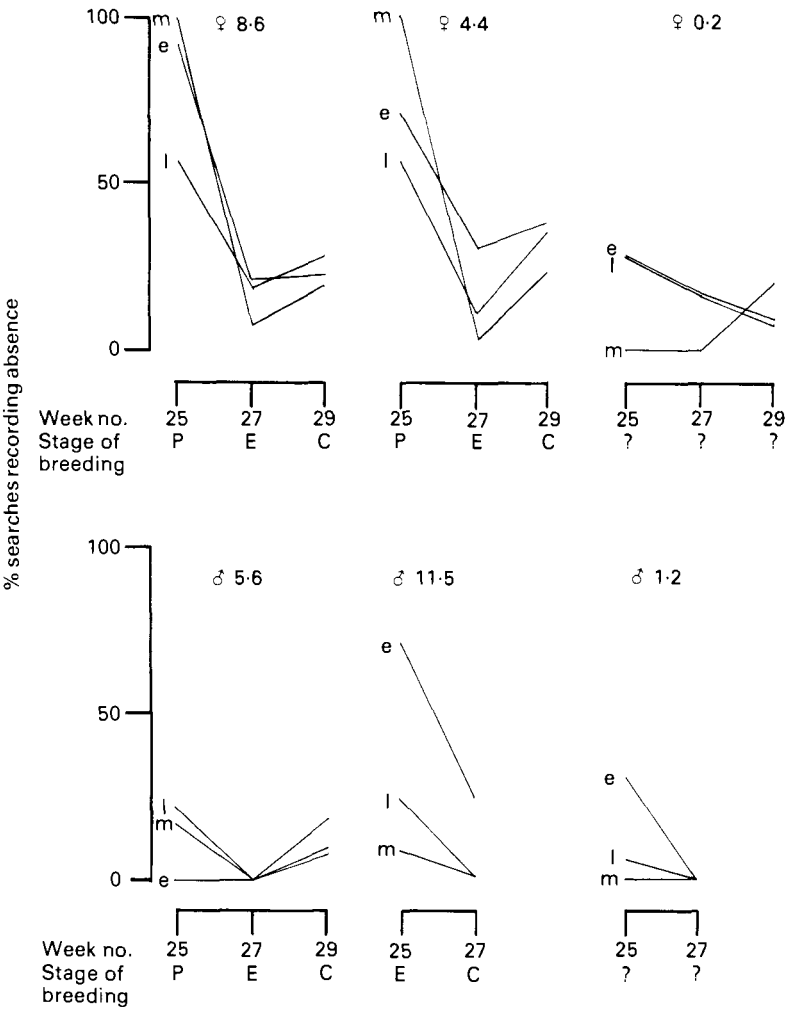

Figure 1. The percentage of searches recording absence of Nightjars during each week at Wareham Forest. Data are from six birds, labelled by sex and radio-tag frequency. Stage of breeding, where known, is shown as P = pre-egg stage, E = with eggs, C = with chicks. Night-thirds are labelled as e = early, m = mid and l = late. The dates of tracking sessions were 16–22 June, 30 June–6 July and 14–20 July.

there were two periods of absence per night (32% of bird-nights at Wareham Forest and 33% at Hartland Heath) and the maximum was four.

The duration of each period away from the nesting area was estimated as the time elapsed since a bird was first recorded as absent and when it was next recorded as present. These records are latest estimates of departure and return giving period estimates accurate to within ± 15 minutes. There was no evidence of a difference in absence rate between the sexes, so data from males and females were pooled.

Over 70% of periods of absence were estimated to be less than 60 minutes. However, some were considerably longer (up to 6 hours) and, as a result, the overall percentages of searches recording absence in each third of the night were similar (29·1%, 22·4% and 22·5% for early, middle and late thirds respectively; Wareham Forest birds). Nevertheless, an analysis which took the relative amount of absence per night-third for each bird-night showed that there was a significant difference in the absence rate between night-thirds (Friedman two-way ANOVA; $X_r^2 = 7{\cdot}19$, $P < 0{\cdot}05$; Wareham Forest birds). Wareham Forest Nightjars were away significantly less during the middle of the night than later ($z = 2{\cdot}457$, $n = 28$, $P = 0{\cdot}014$, two-tailed sign test). They were also away less during the middle of the night than earlier ($z = 1{\cdot}925$, $n = 27$, $P = 0{\cdot}055$), but there was no significant difference in absence between early and late ($z = 0{\cdot}884$, $n = 32$, n.s.).

Fewer birds were tracked at Hartland Heath and, although the pattern was similar (less periods of absence in the middle of the night), the difference between periods was not significant.

In 1986 at Wareham Forest three females and one male retained their tags for all three tracking sessions, while one male and one female retained tags for two tracking sessions. All these birds spent less time away from the nesting area during the period 30 June–6 July than during 16–22 June (Fig. 1). Of the four birds tracked also in the third session (14–20 July) three were away, in each third of night, more than they were during the period 30 June–6 July (Fig. 1).

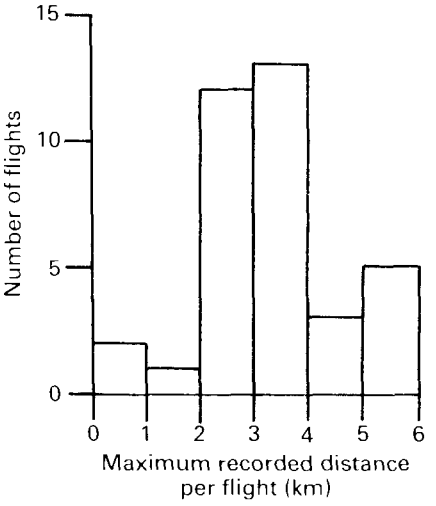

Figure 2. The maximum distances of foraging flights by Nightjars. Data from Wareham Forest and Hartland Heath are combined.

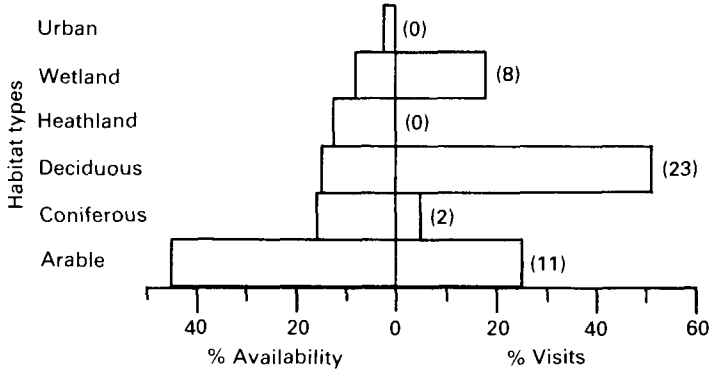

Figure 3. Comparison of availability and use by Nightjars of habitats within a 6km radius of Wareham Forest study area. The deciduous woodland category includes mixed woodland and rural gardens/orchards. The number of visits to each habitat type is given in brackets.

Habitat choice

Among Wareham Forest birds the mean distance ($\pm$ s.d.) from the nesting area to the final site visited was 3·1 $\pm$ 1·2 km. The maximum distance recorded from the nesting area was 5·8 km but we lost track of a few birds that we believe went even further. Most final sites were between 2 and 4 km from nesting area (Fig. 2).

Early in their excursions Nightjars moved fast and frequently between sites, usually successively further from the nesting area. Often it was difficult to determine their location precisely until they reached the last and furthest site, where they usually spent some time but were apparently less active.

When visits to deciduous/mixed woodland and orchards/gardens were combined (Fig. 3) eight out of nine Wareham Forest birds used these habitats significantly more than in proportion to their availability ($P = 0{\cdot}04$, $n = 9$, two-tailed sign test). In contrast, there was significantly less use than expected of grassland/arable ($P = 0{\cdot}004$, $n = 9$) and conifer plantations ($P = 0{\cdot}004$, $n = 9$). Only 8% of available habitat was wetland (stream, watermeadow or marsh) and this habitat was visited by only three out of nine birds, but these three used it 3·5 times more frequently than expected. There were no recorded visits by Wareham Forest birds to heathland or urban areas.

Of the 30 sites, 19 were visited only once, 6 were visited twice and 5 were visited three times. Most revisiting recorded was on consecutive nights.

Discussion

None of the sites visited by radio-tagged birds during their excursions away from nesting areas contained breeding Nightjars, nor were they typical of nesting habitat. We believe that they were used solely for feeding. The most favoured habitats were deciduous or mixed woodland and gardens/orchards. Wetlands, though rare, were visited by some birds more frequently than expected. Despite their greater availability, conifer plantations and improved grassland/arable were little used and there were no records of visits to dry heath.

Some Hartland Heath birds also travelled several kilometres to feed in habitats atypical of Nightjars, including watermeadows and wet heath. Thus this behaviour was not restricted just to the birds breeding in commercial forestry clearings, a less traditional nesting habitat than the lowland heath of Hartland Moor National Nature Reserve.

Our findings support those of Glutz von Blotzheim (1962) and Schlegel (1967), who noted that Nightjars could be seen several kilometres from the nearest nesting areas and sometimes fed near water. They also noted Nightjars feeding near grazing animals. Our habitat survey did not distinguish between grazed and arable fields, so any preference for feeding near animals would not be shown. However, several of the areas visited by Nightjars contained cattle and one site was next to a paddock holding horses.

The study sites in Wareham Forest were among approximately 16 km^2 of commercial forestry, comprising mainly pine plantations of various ages and including the cleared or replanted areas where Nightjars nested. Despite the presence of farmland 500 m south of the study sites, 89% of flights were northward (between north-west and north-east). The birds had to travel at least 1·5 km to reach the forest boundary, which probably explains why foraging flights were rarely less than 2 km (Fig. 2).

We recorded revisiting to 37% of sites, and this was probably underestimated because tracking was usually restricted to one bird per night and birds were tracked on only a few consecutive nights. Also, when the precise position of a bird was not known, we could not judge whether a subsequent visit to the same general area was to the same site. On 4 nights we recorded another tagged bird within 100 m of the one being tracked and on two occasions we saw other Nightjars which were not radio-tagged. Even radio-tagged birds were very rarely seen at feeding sites, so the sighting of unmarked birds was probably indicative that several more were there unseen.

Nightjars nesting in both heathland and clear-fell areas were mostly absent for two periods per night, although absence for one or three periods was also common. The birds spent least time away in the middle of the night and at this time were also least active (Cresswell & Alexander, unpubl. data). The early and late thirds of the night may present the best opportunities for feeding, perhaps due to better light or greater insect activity. Lighter conditions may also be safer by allowing early detection of predators.

The levels of absence of the three females and one male that retained tags throughout the study varied between weeks (Fig. 1). During the tracking session 16–22 June, two of the females had not laid, whereas between 30 June and 6 July they had eggs and between 14 and 20 July they had young. The breeding status of the third female was unknown but the male was mated to one of the breeding females; thus these three birds were most often absent in the pre-egg stage, less absent when they had young and least absent when they had eggs. This suggests that the amount of time spent away from the nesting area may be related to the stage of breeding and supports Schlegel's (1967) assertion that Nightjars feed mainly near their nests after laying. However, another female, which was tracked for only two weekly sessions, had eggs during 16–22 June and young during 30 June–6 July. Despite its more advanced stage of breeding it also had high absence rates during 16–22 June which declined by 30 June–6 July, perhaps indicating the involvement of some environmental factor. In a regression analysis we found no significant relationships between the proportion of time spent away from the nesting area and nightly temperature minima and maxima, rainfall, mean wind-speed and moon-phase. Perhaps the variation in absence was due to a combination of factors (including stage of breeding) or some other unknown variable, such as seasonal changes in the abundance of

favoured prey species. There was also some variability within a night in the amount of time each bird was away, but again this was unrelated to any single factor.

Nightjars visit habitats which are different from those in which they breed and we suggest that these are used for feeding. The high level of site revisiting, the distances travelled on foraging excursions and the selection of areas to the north much further away than apparently similar habitats to the south, all indicate that the Nightjars were perhaps exploiting a few particularly rich feeding sites. Some sites were used by more than one bird, possibly by groups of birds, as described by Lack (1932) and Berry (1979). More detailed study is needed of Nightjar foraging outside nesting sites to determine the importance of these areas during the nesting period and also in the weeks leading up to migration. Measures to conserve Nightjars may need to include preservation of both breeding and feeding habitats.

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References

BERRY, R. 1979. Nightjar habitats and breeding in East Anglia. Br. Birds 72: 207–218.

BERRY, R. & BIBBY, C.J. 1981. A breeding study of Nightjars. Br. Birds 74: 161–169.

CRAMP, S., 1985. The Birds of the Western Palearctic, Vol. IV: 620–637. Oxford: Oxford University Press.

GLUTZ VON BLOTZHEIM, U.N. 1962. *Caprimulgus europaeus*. Die Brutvögel der Schweiz: 331 333. Aarau.

GREEN, R. 1988. Effects of environmental factors on the timing and success of breeding of Common Snipe *Gallinago gallinago* (Aves. Scolopacidae). J. Appl. Ecol. 25: 79–93.

GRIBBLE, F.C. 1981. Nightjars in Britain and Ireland in 1981. Bird Study 30: 165 176.

LACK, D.L. 1932. Some breeding habits of the European Nightjar. Ibis 74: 266–284.

SCHLEGEL, R. 1967. Die Ernährung des Ziegenmelkers *Caprimulgus europaeus*, seine wirtschaftliche Bedeutung und seine Siedlungsdichte in einem Oberlausitzer Kiefernrevier. Beitr. Vogelk. 13: 145–190.

SHARROCK, J.T.R. 1976. The Atlas of Breeding Birds in Britain and Ireland: 262–263. Tring: British Trust for Ornithology.

SQUIRE, T. & ALEXANDER, I. 1981. Capture techniques for full grown Nightjars. Ringers' Bull. 5: 132.

STAFFORD, J. 1962. Nightjar enquiry 1957–58. Bird Study 9: 104–115.