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## Exploring the lives of Goshawks in the Brecks: identifying patterns in nest behaviour, habitat use and movements within and beyond the Brecks

*Dr Ian Henderson and Dr Greg Conway, The British Trust for Ornithology*



*Figure 1.*  
A juvenile female Goshawk at about  
40 days old.  
*Photo © Ashley Banwell.*

### **Introduction**

The Goshawk is a scarce breeding species in the UK, with around 280–430 pairs in total (Musgrove *et al.* 2013), and is protected under Schedule 1 of the Wildlife and Countryside Act 1982. The Breckland is a regional stronghold for this exciting but very elusive bird of prey, supporting perhaps about 25 territories. The species should be a relatively common breeding raptor in the UK and although the national population is slowly increasing,<sup>1</sup> there is much regional variation, probably due to low recruitment, where persecution may still play a role.

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<sup>1</sup> Balmer *et al.* 2013.



East Anglia is typical of a lowland region in the UK where the Goshawk population is far below carrying capacity, although in the Brecks the species is regarded as a headline representative of the bird fauna. As such, the Forestry Commission and dedicated volunteers take active steps to help protect nests and breeding habitats within Thetford Forest. Prior to this study, however, literally nothing was known of this population's movements, scale of interaction with the wider countryside, or its relative use of forest, farmland or heathland.

A key aim of the study was therefore to improve our understanding of the species' dispersal behaviour. Would young birds remain within the Breckland population or would they move away to recruit into the wider population of East Anglia? Also, little was known about the core diet of the birds breeding locally, so another aim was to quantify the composition of the chicks' diet, as a potential limiting factor on population expansion. Of course Goshawks are, famously, elusive and furtive and not amenable to normal visual observation. Now, modern methods of tracking have opened up opportunities for objective investigations into some of the mysteries of the bird's life and potentially also sources of its mortality.

## Methods

### Tracking

In 2016, two Goshawk chicks, a male and a female from different nests, were fitted, under licence, with GPS tags and provided our first dispersal data. The GPS tags were fitted as a backpack using smooth but strong material, Teflon ribbon, to construct the harness. Each harness is individually fitted to the chick at between 25 and 40 days old, when the skeletal structure has fully developed (*Fig. 1*). Care was also taken to allow for muscle development in the larger female in particular when fitting harnesses. The tags attempted two GPS locations per day (approximating to mid-day and evening) and the data were transmitted via the GSM mobile network after six fixes were received (normally every three days but with periods of dormancy in poor weather).

### Chick diet

In addition to the tagging, in 2015 we installed cameras on three Goshawk nests containing hatched chicks, under licence (representing the north, middle and south regions of the forest). This was to identify the staple diet of chicks and look for consistency or variations between nests. A small, camouflaged infrared motion-sensitive camera (maximum dimensions 4cm x 4cm) was fitted to a nearby branch by each nest. A record was also kept of the prey discovered at the base of the nest tree (always visited under licence) as well as within the nests, when being visited to ring the chicks.

## Results

### Tracking

#### Dispersal and movements

The patterns of behaviour and movement in juvenile birds were consistent with other studies.<sup>2</sup> At 30 days old the chicks remained within the nest, but from 35–40 days moved increasingly on to the nearby branches as their flight feathers developed. The birds became increasingly restless between 50 to 60 days old. The typical distances travelled were around 50m to 100m from the nest site, rarely to 200m away (*Figs. 2a & b*). Between 60 to 70 days old, the birds were typically

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<sup>2</sup> eg, Kenward, 2006.

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ranging over distances of 100m to 200m, though still essentially remaining within the natal wood (Figs. 2c & d). At this age, the birds were capable of longer flights with occasional excursions being recorded, including one to a distance of 7km from the nest site, before returning the same day (perhaps following an adult). At 70 days old, in both individuals, the point of departure from the natal area was abrupt and now strongly directional, as they moved far from the natal area (Fig. 2e). Both birds travelled distances of 30–35km over a period of three days, and both individuals adopted a nomadic life style with constant daily movements between locations, typically of 5–6km. Rarely more than two days was spent in any one specific location. At about 80 days old, the female began to settle into a pattern, covering a large 30km<sup>2</sup> area of mixed farmland and woodland in north-west Norfolk, some 30km from her natal area. Unfortunately she was found dead in this area near a road, possibly as a road casualty. The tag was returned to the BTO working and intact. Interestingly, the male, having also initially moved 35km away, this time north-east via the Wissey river valley to Swanton, Norfolk, then acted differently. This bird looped back to Thetford Forest after 15–20 days via visits to Thompson/Merton and the fens near Feltwell. This bird's last recorded position in Thetford Forest was within 3km of its original nest site.

Figures 2a–2e. Projections of the pre-dispersal movements of two juvenile Goshawks from 50 days old (a) & (b), becoming increasingly restless up to 70 days old (c) & (d). Dispersal is abrupt and directional at around 70 days (e; yellow track is the female, blue track is the male).



Figure 2a.



Figure 2b.



Figure 2c.



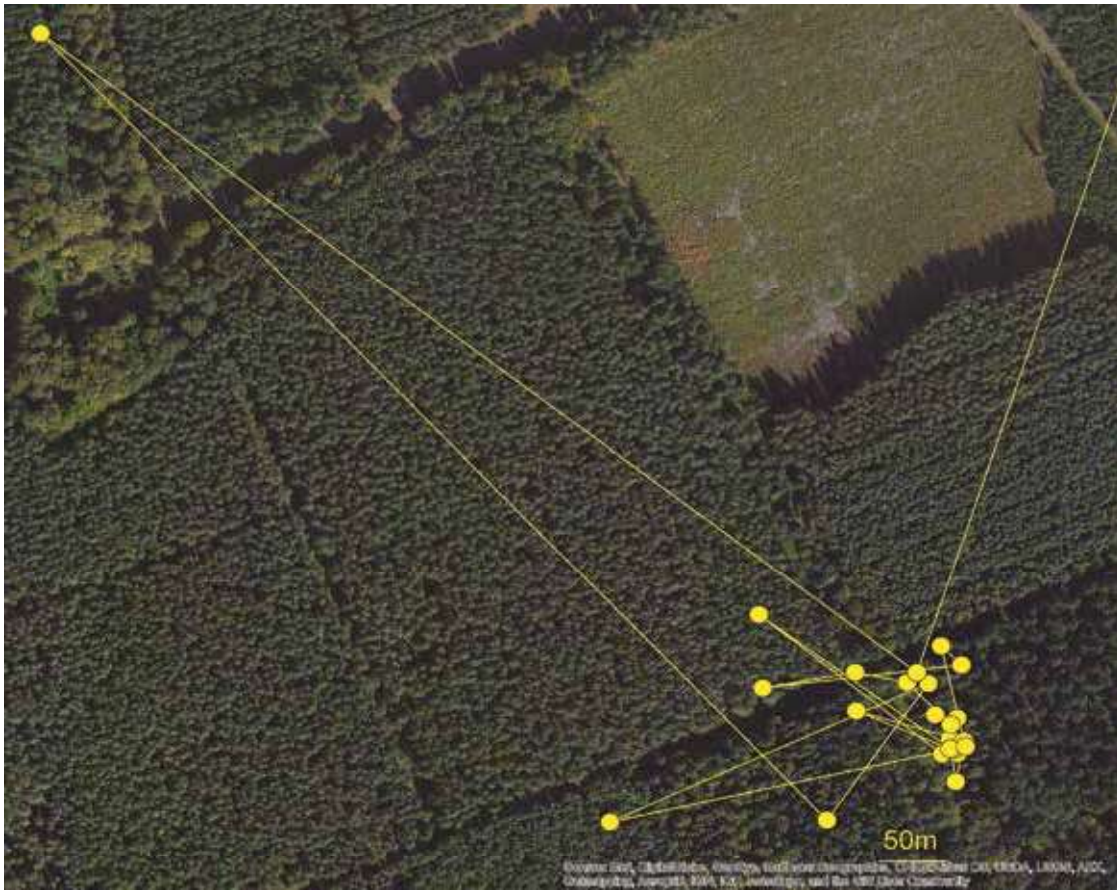


Figure 2d.



Figure 2e.



*Figure 3.*  
A typical pattern of movement and habitat use in a juvenile Goshawk. Close inspection will reveal the bird moving regularly across open farmland, from woodland edge to shelter belt and so on. Broadly speaking, the circles represent daily GPS fixes.

were located on open fields, as would be expected by chance due to their large proportional area of coverage. Most diurnal GPS locations are centred on small patches of woodland, the edges of woodland or on narrow shelter belts, but rarely the larger areas of woodland or forest (*Fig. 3*). It is possible that the use of dense forest could be underestimated if the tags are less likely to acquire GPS fixes there. But in our case there were very few missing data points in the sequence to suggest this was a common event. Also, the tags were working quite well in the forest to begin with, before birds dispersed. So all in all, the pattern suggests the birds were moving swiftly and regularly between edge habitats. The evening GPS points were similarly scattered, suggesting the birds were mainly roosting opportunistically rather than in selected or preferred woodlands or woodland structures. Generally, the pattern was of an itinerant lifestyle at this young age.



### **Nest attendance patterns**

At the nest, the behavioural patterns are all consistent with previous studies of Goshawks.<sup>3</sup> The female typically left the nest very early in the morning, sometimes before dawn, returning every hour or two with nest material and occasionally with food (provided by the male), but the longest period of parental absence was six hours. Nest repair and maintenance was undertaken continually by the female,

<sup>3</sup> e.g., Kenward 2006.

who brought fresh greenery throughout the entire nesting period. The smaller male undertook the majority of the hunting and delivered prey, but only the female fed the chicks (Fig. 4). The female did all the nest attendance, nest maintenance and protection (being aggressive towards the male too). Sometimes she covered young chicks at night or in wet or cold weather, but very often the chicks were exposed for long periods of time with the female absent either hunting or finding nest material.



Figure 4.  
Adult female Goshawk in attendance at nest with female chick.  
Photo © Forestry Commission.

### Chick diet

Prey was usually delivered to the nest ‘processed’ (plucked, headless), so precise identification was at times challenging, as was the identification of remains in the vicinity of the nest. Usually, the legs provided the best clue. The diet data are new for the Brecks, and overall the principal prey at this stage of the life cycle was Grey Squirrel *Sciurus carolinensis*, making up over half (average 64 per cent) of all items (Fig. 5). However, Wood Pigeons *Columba palumbus* and crow species (typically nestlings or recently fledged Carrion Crows *Corvus corone*, Rooks *C. frugilegus* or Jackdaws *C. monedula*), plus Jay *Garrulus glandarius* and Magpie *Pica pica* were also significant. Other animal species recorded less frequently, in or by nests, included Rabbit *Oryctolagus cuniculus*, Green Woodpecker *Picus viridis* and Red-legged Partridge *Alectoris rufa*. Figure 5 shows that there were differences in the proportions of species being delivered to nests, with Grey Squirrels being especially dominant at one site, but with more variety at the others, probably depending on availability. All three nests successfully fledged three young in 2015.

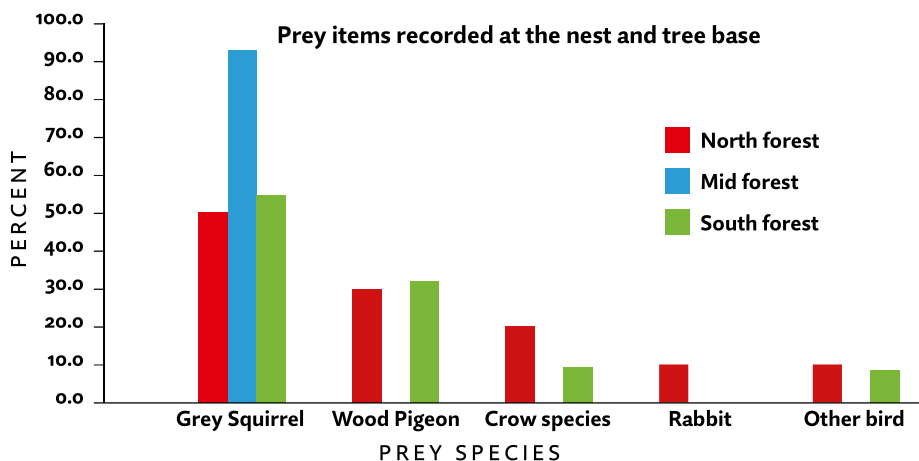


Figure 5.  
Breakdown of the percentage of prey items identified at three different Goshawk nest sites (mainly at the nest but including the nest tree base). ‘Other bird’ includes Green Woodpecker, Red-legged Partridge and ‘unidentified bird’.



### Discussion

For all species, we need to understand fundamental aspects of their lives in order to manage habitats and landscapes appropriately, with informed decisions using evidence-based observations. The Lawton report<sup>4</sup> extolls the virtues of being bigger, better and more connected, but without knowing the scale over which organisms move, these qualities can remain quite notional. For Goshawks in the Brecks, the present project was at least able to help us develop an initial understanding of the scale and qualities of the countryside we may need to consider when thinking about conservation initiatives for this species. There is so much more to learn, but this project was a new venture and an essential foundation for future work.

From the two operating tags, we now appreciate the scale of movement that the Brecks' juvenile Goshawks can undertake. This was previously unknown but allows us to understand the potential of the birds to disperse and mix, and for the population to connect easily with areas far beyond the Brecks. Their movement suggests that the dispersed population of East Anglia may interact freely, and overall this flux of movement will benefit the longer-term viability of the Goshawk population across East Anglia. It is tantalising to suggest that the Brecks population may be an important source for colonisation across East Anglia, but confirmation would require further data, and of course the opposite could also be true.

We discovered that the young birds disperse suddenly (the trigger could be denied food or active displacement by the parents<sup>5</sup>); and that they are highly mobile and itinerant in lifestyle, which seemingly belies their furtive character. Our data indicate the important use of the shelter belts, forest edge and wood lots across open or mixed farmland. These birds were not confined to large forest habitats but ranged widely and with as much dependency on farmland as on forest, moving from woodland patch to woodland patch. Currently, we have data from two birds only and we do not know how typical those movements are. But if the birds are at least partly representative of this species locally, it raises issues of wider interest. First, from a conservation perspective, a more landscape-integrated perspective may be required in thinking about the needs of the species beyond the forest. Second, the farmland interaction raises concerns about potential conflicts with gamebird management.

It would have been desirable within this project to have seen the birds survive into the following spring, so that we could witness patterns of settlement into new territories, either within the Brecks or beyond. The male and the female were different in this regard. The male may have had to return to the Brecks because he was struggling to find food outside the forest, or perhaps there were conflicts with other Goshawks? Would the male have established a new territory within the Brecks? Would the female have settled in north Norfolk? These are aspects of the species' behaviour that we would like to pursue with future work.

Interestingly, the staple prey of the forest Goshawks for feeding young at least was Grey Squirrels, Wood Pigeons and crow species. Red-legged Partridge was recorded once but not Pheasant *Phasianus colchicus*, probably due to Pheasants being too large to be carried to nest sites. One source suggests that for Goshawks breeding within Stanford Training Area (STANTA), Wood Pigeons dominate the prey count, followed by crow species and with Grey Squirrels in third place,<sup>6</sup> again

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4 Lawton, 2010.

5 Kenward, 2006.

6 Feakes and Pleasance, 2016.



probably reflecting differences in prey availability. Nevertheless, these are common prey species and the diet for chicks at least is unlikely to be limiting the population trajectory of Goshawks locally. Interestingly, all of the common prey species are subject to 'control' to some extent by land managers, yet the potential net benefit provided by some birds of prey is a subject rarely aired or promoted!

### **Acknowledgements**

The Goshawk population in the Brecks is closely monitored, as has been the case for decades. This requires strong and devoted volunteer input, with dedicated and knowledgeable individuals who attribute hours of free time to nest finding and nest monitoring – in particular, we thank Bernard Pleasance in this regard, as well as Simon Evans for organising the nest site logistics. The Forestry Commission England also maintains a strong interest in the species, encouraging understanding of its use of the forest estate. We would also like to thank Neil Thomas for tree climbing services, often in his own free time. Photos are by Peter Dolton, Paul Stancliffe, Ian Henderson and Ashley Banwell. The funding for the BTO Goshawk tagging project was provided by the Breaking New Ground Landscape Partnership Scheme in the Brecks, supported by the Heritage Lottery Fund.

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