Post fledging dispersal in Barn Owls *Tyto alba* in Shropshire and its implications for the sustainability of a breeding population

Glenn Bishton, John Lightfoot and Wendy Lightfoot

Introduction

The prime aim of the present study was to determine the dispersal distance of chicks from their natal site to their first breeding site and juvenile dispersal distance from ringing recoveries in the first and second years of life. Differences in dispersal according to sex were also examined. It was envisaged that the findings would facilitate an assessment of the sustainability of the Barn Owl breeding population in Shropshire and inform conservation measures.

Barn Owls are non-migratory in the UK (*Pringle et al 2016*), defending home ranges and hunting within 2 km. of the nest (*Cayford 1992, Taylor 1994*). Adult males are highly site-faithful and females more frequently move to new nest sites, usually after losing their mate and no further than to an adjacent nest site (*Taylor 1994*). Post-fledging dispersal begins around 98 days old (*Bunn et al 1982*) and radio-tracked fledglings were first found to be absent from the nest area at 83-116 days old, mean 96.6 days (*Barn Owl Trust 2012*). The median dispersal distance for ringed-recoveries is 12 km and dispersal is largely completed within the first five months of fledging (*Wernham 2002*). Female chicks disperse further than male chicks (*Pringle 2016*).

Shropshire Barn Owl Group (SBOG) has been installing nestboxes for Barn Owls in Shropshire and promoting the conservation of their habitat since 2002. Four-hundred and forty-two nestboxes have been erected and 1895 chicks produced in nestboxes monitored. An additional 304 chicks have been produced in natural sites (*SBOG 2020*). This has led to an increase in the Barn Owl breeding population from an estimated 140 pairs in 1992 (*Deans et al 1992*) and 121 in 2002 (*Bishton and*

Lightfoot 2004) to 200-220 pairs in 2013 (*Smith 2019*). This intensive conservation effort to provide new breeding opportunities for Barn Owls in Shropshire has produced a large dataset of chicks ringed under BTO licence and subsequently recaptured live (hereafter "live-recaptures" or recovered dead (hereafter "dead-recoveries"). There has been no previous detailed analysis of ringing recoveries and the dispersal from natal sites in Shropshire.

2 Methods

Ninety-one Barn Owls ringed as chicks in Shropshire and recaptured live or recovered dead between 10 August 2007 and 26 May 2020 were available for analysis. Ringed nestlings found dead in the nest and young owls recovered dead close to the nest site and which clearly had not attempted to disperse were excluded from the analysis. Injured birds subjected to treatment and ringed then released from a site were similarly excluded from the analysis as the link to the natal site had been compromised.

Dispersal movements were categorised into different types according to the age at which the chick was ringed and subsequently recovered. Natal dispersal is defined as the movement of chicks from the nest site to recovery locations in any subsequent breeding season. The breeding season is defined as 1 April - 31 October following Wernham et al (*2002*). SBOG has recorded Barn Owl chicks from second or late broods in the nest in October and which would subsequently fledge as late as November but the range dates applied here will include most breeding attempts in Shropshire.

Juvenile dispersal is defined as the movement of chicks from the nest to recovery locations within 12 months of ringing. For the purpose of this study Barn Owls recovered over 12 months after ringing are termed young adults. Median and mean dispersal distance were calculated for each dispersal type among live-recaptures and dead-recoveries.

The sex of the chicks was routinely determined on ringing using criteria defined by the Barn Owl Trust and British Trust for Ornithology. Identifying recoveries according to sex was also undertaken on dead Barn Owls retrieved by SBOG or bought to their attention. The sexing of juveniles allowed for comparisons to be made in the dispersal distances of male and female birds. Analysis of the data for the cause of death and evidence of seasonality was undertaken.

A brood of four *(Glenn Bishton)*

3 Results

3.1 Natal dispersal

The median natal dispersal distance for juvenile live-recaptures and dead-recoveries was 7.0 km. (n=35, mean 18.00 +/- 4.85, Table 1). Females dispersed 9.0 km, further than males, which dispersed 6.0 km. One recovery was not identified according to gender. Live-recaptured female Barn Owls dispersed greater distances than live-recaptured males. This gender difference was also found to hold for dead-recoveries. Live-recaptured males, females and both sexes combined dispersed further than the equivalent birds found dead on recovery, which suggests that live-recaptures provide a more precise measure of dispersal and that birds recovered dead might still be in the process of dispersing when recovered.

Table 1. Natal dispersal distance (km) of live recaptures and dead recoveries

Means are presented with standard errors (se)

N=number of birds in each category

	Live recaptures			Dead recoveries			Live recaptures & dead recoveries		
Sex	N	Median dispersal	Mean +/-se	N	Median dispersal	Mean +/-se	N	Median dispersal	Mean +/-se
M	4	7.00	6.25 +/-1.55	4	6.00	7.00 +/-2.12	8	6.00	6.63 +/-1.22
F	21	9.00	20.95 +/-6.46	5	7.00	26.20 +/-16.81	26	9.00	21.96 +/-5.99
M&F	25	9.00	18.60 +/-5.52	10	6.00	16.50 +/-8.59	35	7.00	18.00 +/-4.58

The minimum natal dispersal distance for a male live-recapture was 2 km. for an individual ringed at Attingham on 18 July 2016 and recovered dead at Berwick on 26 June 2017. The maximum for a male live-recapture was 9 km. ringed at Sleap on 7 July 2012 and recaptured at Ellesmere on 23 June 2016. The minimum natal dispersal distance for a female live-recapture was 2 km. by an individual ringed at Sleap on 28 August 2014 and recaptured at Burlton on 6 June 2017. The maximum natal dispersal distance for a female live-recapture was 114 km., ringed as a chick at Longden on 3 August 2015 at and recaptured at Fenny Compton, Warwickshire, on 15 June 2017.

The maximum natal dispersal distance for a dead-recovery was 92 km. for an individual ringed at Ellesmere on 25 June 2009 and recovered 628 days later on 26 April 2011 at Weston Underwood, Derbyshire.

3.2 Juvenile and young adult dispersal

Juveniles dispersed 6 km. (n=52, mean 13.65 +/- 3.13) in the first 12 months (Table 2). Young adults over 12 months dispersed 10 km. (n=35, mean = 22.26+/-4.66), further than juveniles in the first 12 months and indicating that the dispersal of young Barn Owls continued in their second year of life. Both juvenile and young adult females dispersed greater distances than juvenile and young adult males.

Table 2. Dispersal distances (km) of live recaptures and dead recoveries of juveniles in the first 12 months and of young adults in the second 12 months.

Means are presented with standard errors (se)
N=number of birds in each category

	First 12 months			Second 12 months		
Sex	N	Median dispersal	Mean +/-se	N	Median dispersal	Mean +/-se
M	18	5.0	6.83 +/-1.78	5	9.0	20.20 +/-11.26
F	28	7.5	16.50 +/-4.63	25	14.0	29.32+/-7.15
M&F	52	6.0	13.65 +/-3.13	35	10.0	22.36 +/-4.66

The maximum juvenile dispersal was 99 km. for a Barn Owl ringed at Ellesmere on 9 June 2007 and recovered dead at Trefechan, mid-Wales, on 10 August 2007. The large dispersal distance in 62 days suggests that it may have been vehicle assisted.

Fitting a ring to a nestling Barn Owl *(Tim Preston)*

3.3 Cause of death of juveniles and young adults

Seventy-four dead-recoveries were available for analysis. Cause of death was not always recorded or apparent and some recoveries referred to a place of recovery only. The predominant location or cause of death was road casualties 60% (n=41). Other causes of death referred to a field 13% (n=9), dead in a building 7% (n=5). No record of location or potential cause of death occurred in 7% (n=5) of cases and birds found dead on a yard or track, where collision with a vehicle or wires was feasible, predation, drowning, railway and garden accounted for 2% or less each (n=8).

Data for dead-recoveries must be treated with some caution as it may be subject to some bias in favour of road casualties. Road victims are conspicuous and in places frequented by people and other deaths will probably go undetected in more secluded locations, such as natural tree sites, where the cause of death may be starvation or poisoning. In addition, without direct observation of the cause of death, most descriptions will inherently contain assumptions about the cause of death. 75.6% (n=56) of juvenile deaths occurred within the first 12 months of their lives.

Chicks were routinely aged on ringing using the BOT's growth and development chart (*Barn Owl Trust 2012*) and this is extrapolated to calculate an approximate (maximum) age of chicks at death. For those surviving beyond 12 months the average maximum age at death was 1,158.08 days (+/-202.01 n=12). The oldest juvenile was an individual ringed at Peplow on 9 June 2012 and found dead 2,455 days later at Admaston, nearly seven years of age. 66% (n=45) of casualties occurred in the winter period October-March.

4 Discussion

Juvenile Barn Owls in Shropshire move away from their place of birth soon after fledging. Dispersal distance from the natal site to their breeding site and juvenile dispersal from the natal site to the place they settled in their first twelve months of life was less in males than females: the median natal dispersal distance for males was 6 km. and for females 9 km., whilst the median juvenile dispersal distance was 5 km. for males and 7.5 km. for females (data for live-recaptures and dead-recoveries combined).

The point at which dispersing juveniles opt to settle will be dependent on a range of factors – the availability of an adequate food resource, suitable roost and nest sites and the presence of a potential mate or competitor. By the end of November most juveniles have settled in their home range (*Wernham, et al 2002*) and most of the sites occupied are where a vacancy exists due to the death of a resident, new arrivals pairing

up with the resident bird (*Taylor 1994*). It is feasible to assume that dispersing juvenile Barn Owls in Shropshire will move the minimal distance required to secure suitable feeding habitat, roost sites, a mate and a nest site. Environmental conditions prevailing during dispersal – prey abundance and nesting sites – are more important factors in determining how juveniles disperse than the conditions of the individual (*Roulin 2020*).

Natal dispersal as measured by live recaptures is most definitive as it records juveniles in situ on breeding sites and therefore the precise distance from the natal site to the first breeding site. For birds found dead, recovery distances and timeframes contain an element of presumption that the birds were breeding or attempting to breed in the location where they were recovered rather than killed prematurely whilst still in the process of dispersal. However, the fact that such recoveries appeared to disperse shorter distances than birds recovered live suggests that biases inherent in determining dispersal distances from dead birds, such as vehicle assisted travel, might not significantly influence the outcome.

The short dispersal movements performed by Barn Owls in Shropshire has implications for SBOG's nestbox programme. Based on a tentative understanding of home ranges in Shropshire, SBOG has previously attempted to create and subsequently expand core breeding populations in areas of good feeding habitat but where the absence of suitable cavities existed in trees or buildings for nesting and roosting purposes. For example, the number of breeding pairs on The Weald Moors, north of Telford, increased from one to nine pairs between 2002 and 2005 following the installation of 29 nestboxes. The present study would suggest that a programme of linked nestboxes, with some as close as 220 metres apart in cases to provide roost sites as well as nest sites, might act as a stepping-stone for juveniles dispersing from their natal site and attempting to move the minimal distance to find suitable nest and roosting cavities.

Most juvenile deaths in Shropshire Barn Owls occurred in the first 12 months of their lives and most occurred in the winter period. The Barn Owl population is probably at its post-breeding peak at this time and this seasonality of deaths is consistent with SBOG data on road casualties which shows that 63% of road deaths between 2002 and 2019 occurred in the winter period (*SBOG 2019*). This seasonality has been observed elsewhere in the UK (*Percival,1990, Taylor 1994, Shawyer and Dixon 1999*), with high juvenile mortality throughout the dispersal phase and a peak in late October, early November. The increased foraging ranges of adult Barn Owls in winter probably results in a greater chance of encountering vehicles. A second mortality peak in late winter due to an increase in the adult die-off rate is apparent from SBOG road casualty data and, again, is consistent with studies elsewhere (*Percival 1990, Taylor 1994*).

Road traffic casualties accounted for most juvenile deaths in Shropshire. SBOG recorded 201 road deaths between 2002 and 2019, an average of 11.1 each year (*SBOG 2019*). Ninety-two percent occurred on A roads. The A5 is the most serious threat, accounting for 34% (69) of the casualties. In the UK, road traffic accounted for 6% of mortality between 1910-1954 rising periodically to 52% in 1982-1986 (*Roulin 2020*) and with constantly increasing traffic volumes this threat is likely to persist in Shropshire. Mitigation to reduce road kills might include tree planting on road embankments and close to roads which would force Barn Owls to fly high above roads, but any mitigation is unlikely to be implemented on a large scale. SBOG policy of ensuring that nestboxes are not installed within 1 km. of a major road is possibly the most prudent option at present.

Are there any geographical and topographical impediments to the dispersal of juvenile Barn Owls in Shropshire which might restrict their breeding range? Barn Owls move further through better habitat (*Pringle 2016*) and are impeded by large natural barriers such as large expanses of water (*Shawyer 1994, Seel, et al 1994*) but there is no evidence that they disperse along linear features such as waterways or road verges. The movement of radio-tracked juveniles appeared to be unrelated to habitat features, juveniles flying over hills rather than following river valleys (*Barn Owl Trust 2012*). Possibly the greatest natural geographical barrier that might impede their movement and restrict their breeding range in Shropshire is the Shropshire uplands of the Long Mynd and the southern Clee Hills in south Shropshire, rising to 540 metres asl. Around 90 tetrads (33% of the total occupied breeding tetrads) in the uplands were occupied by breeding pairs between 2008-2013 (*Smith 2019*) and sites occupied in the south are generally located along the lower ground of river valleys and catchment areas. Here, SBOG has been assisting the community wildlife groups in the Upper Onny, Upper Clun, Kemp Valley and Clee Hills where nestboxes have been installed and are now occupied by breeding pairs. Given that SBOG has recorded a pair nesting as high as 357 metres asl at Black Marsh, Chirbury, the limiting factor in further breeding range expansion in the southern uplands is probably the lack of tree cavities and buildings rather than the hills acting as a physical barrier to movement.

The mean number of chicks produced per successful brood in Shropshire for the eighteen years 2002-2019 is 2.9 (*Lightfoot and Bishton 2020*), ranging from 2.1 in 2010 to 4.1 in 2014. An average of 3.2 young per pair is required to maintain a viable population (*Taylor 1994*). Seventeen recoveries in the period analysed related to Barn Owls ringed as chicks outside the county which indicates that there is some immigration of Barn Owls in Shropshire. Given the small dispersal distance of juvenile and the acceptable breeding productivity it appears that the population in Shropshire is presently viable, self-sustaining and not reliant on the immigration of Barn Owls.

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