MERSEYSIDE RINGING GROUP

Annual Report 2016

A review of the status of Pied Flycatchers at Prion, 1986-2016 *Peter Coffey*

MERSEYSIDE RINGING GROUP

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Cover: a White-crowned Sparrow *Zonotrichia leucophrys gambelii*, caught and ringed at Woolston on 30 April 2016. It has been accepted by British Birds Rarities Committee as belonging to the subspecies *gambelii*, a new subspecies for Britain, and is only the second White-crowned Sparrow to be ringed in the UK. (Photo: D Bowman)

Acknowledgements

Merseyside Ringing Group receives vital co-operation from many landowners, farmers and gamekeepers in Merseyside, Cheshire and north Wales. They permit group members to work on their property and without their generous help, much of the work of the group would be impossible. The Group also receives considerable support from local authority countryside and ranger teams, local Wildlife Trusts and private individuals. Thank you all for your support.

Maps showing the distribution of controls and recoveries have been produced using DMAP.

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CONTENTS

A REVIEW OF THE STATUS OF PIED FLYCATCHERS AT PRION, DENBIGHSHIRE 1986-2016

Peter Coffey

Summary
After changes to nest box management at Prion, including a significant increase in the number of nest boxes and replacement of old boxes in 2007, the breeding performance of the local Pied Flycatcher population has been analysed. Clutch size remains unchanged even though first egg dates have advanced but hatching success has dipped slightly. Chick deaths were relatively high between 1998-2011 and the number of fledglings per nest has been consistently lower than the UK average. A recent revival in the fortunes of the local population, based on three consecutive years of good reproductive success, would not have been achievable – and would not have been recorded – if changes to the nest box management had not been implemented.

Introduction
Looking back at a review of my first twenty years ringing at Prion (Coffey 2005), the outlook was gloomy:

> "There is no escaping the fact that the Pied Flycatcher population at Prion is struggling. Large declines in the size of the breeding population coupled with declining proportions of chicks that fledge do not bode well. More alarmingly, the population in the upper valley fell sharply in 2003-05, at a time when the lower valley population increased slightly. The egg/fledged young survival rate has been below 50% for each of the last four years. Such consistently poor performance has not been recorded before in either section of the valley."

This trend had mirrored a national decline. During the period of study, the Population Status of Birds in Wales report changed the classification for Pied Flycatcher from green list (in 2002) to red list (Johnstone & Thorpe 2010) because of a decline of at least 50% in the breeding population over the 25 years 1981-2006. The latest report, Birds of Conservation Concern in Wales 3 (Johnstone & Bladwell 2016), confirms the red list classification. Across the UK, Pied Flycatcher had been on the amber list in BoCC3 (Eaton *et al* 2009) and is now on the BoCC4 red list (Eaton *et al* 2015).

1:A pair of Pied Flycatchers feeding young at Prion (Photo: L Coffey)

The potential causes for the decline could be any or all of the following: a deterioration in the environment in their wintering quarters in West Africa; destruction of habitat along their migration routes, particularly in key stopover areas such as the cork oak groves in Portugal; and changing conditions in breeding areas. An analysis of long-term UK Pied Flycatcher population trends using BTO data finds little evidence to suggest the decline in UK Pied Flycatchers is the result of change in the breeding habitat or per capita reproductive success (Wright *et al* 2004). This article reviews the performance of the local Pied Flycatcher population between 2006-16 and explores local environmental factors that may have led to the identified changes.

The site

The study area is located in a 2.3 km section of a deep valley running approximately west to east towards the Vale of Clwyd. The habitat changes from open, exposed hillsides in the upper valley to narrow, steeply sloping, sheltered valleys in the lower section. The woodland is predominantly sessile oak although there are areas of mixed deciduous woodland and some areas of coniferous trees. Parts of the upper valley are grazed. Most woodland has low ground cover – predominantly grasses, brambles, bluebells and other woodland flowers – but holly, rhododendron and laurel colonise some areas (see photos **2-5**).

2-5: predominantly oak woodland (clockwise from top left): on steeply sloping hillside grazed by sheep; on gently sloping land occasionally grazed by cattle; enclosed with no grazing and limited understorey in upper valley; enclosed in lower valley with no grazing on steeply sloping hillside with occasional stands of holly, laurel and rhododendron. (Photos: P Coffey)

The total area of woodland in which nest boxes are situated is 14 hectares. Altitude varies from 80-205m above ordinance datum (AOD). Almost all nest boxes are located on the south side of the valley; a group of four boxes are sited on the north side of the stream in the lower valley and eight boxes are on the crest of the hill facing west in the upper valley.

Changes to the nest box management in 2007

The number of boxes in 1986 started at 54, rose to a peak of 76 in 1995 and then fell to 68 in 2006; the deterioration in the condition of retained boxes left a lot to be desired. My MRG colleague, John Birch, advised me when I first took on the Prion site that numbers of Pied Flycatchers would fall after a few years unless new boxes were provided, advice confirmed in later studies (Lundberg & Alatalo 1992; Vilka 2003). The latter identified the internal light condition of boxes as a key factor for Pied Flycatcher in nest selection and recommended changing boxes every four years.

After a review of the nest boxes, the following decisions were made:

- the area of woodland covered by the study would remain unchanged
- the policy of leaving boxes unblocked, allowing unrestricted access to all species of hole-nesting birds, would remain unchanged
- the number of boxes would be increased significantly. An initial increase to 100 was made in 2007 and then incrementally to 117 by 2010 and 129 by 2016
- old boxes in locations preferred by Pied Flycatchers would be replaced with new boxes
- old boxes preferred by tits would be left unchanged
- the use and condition of boxes would be monitored, with all boxes used by Pied Flycatchers replaced at least every seven years.

Monitoring of Pied Flycatcher nests was increased, with the target of accurate recording of first egg dates and the capture of all adult birds in addition to standard nest recording and pulli ringing. All nest record data were submitted to the BTO's Nest Records Scheme, and information on captured adults, backdated to the start of the study, has been submitted to the BTO's Retrapping Adults for Survival scheme (RAS).

Results

With the exception of figure 1, analysis in this section excludes data from 1986-87 whilst the study was being set up and no data is available for 2001 because the site was not visited during the foot-and-mouth outbreak. Figure 1 shows the occupancy of nest boxes at Prion. In the early years of the study, 21-23 breeding pairs used nest boxes. In 1992 the number of boxes and area of woodland covered were expanded. The number of breeding pairs increased to an average of 32 in 1992-1998 but this was followed by a collapse in 1999 to just 18 pairs. A partial recovery in 2000-06 resulted in the average rising to 22, still far short of the previous level. In 2007, when the number of boxes was increased substantially and old boxes replaced with new, breeding pairs rose to 31 but that proved to be a short-lived spike. Pied Flycatcher nests fell back gradually,

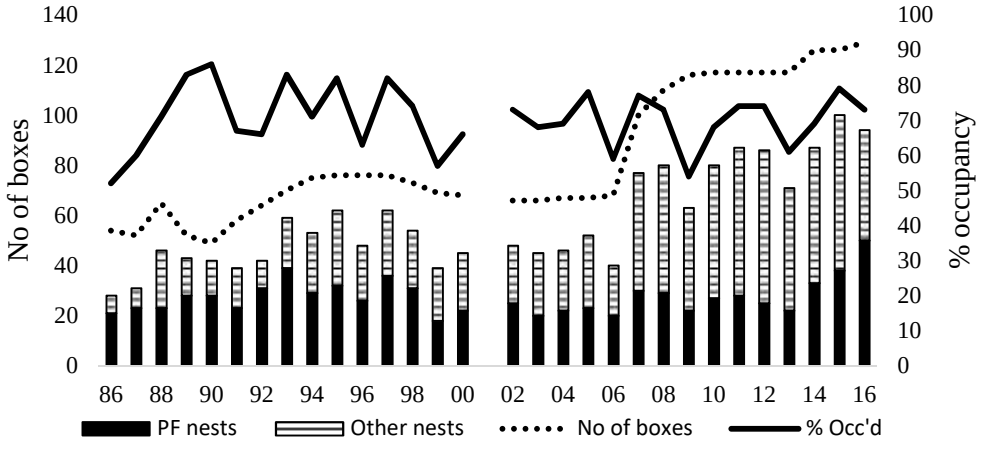


Figure 1: Nest box numbers and occupancy at Prion, 1986-2016

dropping to 22 by 2013 even though 17 more boxes were added. Since then, 33 breeding pairs were recorded in 2014, 38 in 2015 and 50 in 2016, a 127% increase in three years. During this three-year period, 12 boxes were added, an increase of 10%, and the overall increase in boxes since 2006 is 90%.

Competition for nest sites from other species, predominantly tits, is one potential cause cited for the decline of Pied Flycatchers. Most Great Tits and Blue Tits will be defending nest boxes when the Pied Flycatchers start prospecting and, from my observations over the years, both will drive away Pied Flycatchers. The number of boxes occupied by tits and other species remained remarkably consistent between 1992 and 2006, averaging 24 nests per year, but more than doubled in response to the provision of additional boxes, averaging 52 nests per year between 2007-16. Overall occupancy for the whole study period has ranged from 54% to 86% but ten-year averages between 1997-2006 and 2007-2016 are remarkably consistent at 69% and 70% respectively.

The availability of boxes may have been a limiting factor (see Discussion below) but other factors, such as the advancement of spring, levels of predation and weather-related nest failures may have a bigger impact on the overall status of the local population and are examined below.

Advancement of egg-laying

The advancement of seasonal events in spring over the last few decades is a widely-recognised phenomenon. Pied Flycatchers are long-distance migrants so the timing of their departure for breeding grounds is triggered by day-length rather than conditions in the breeding area (Both and Visser 2001). Their arrival may be delayed if they encounter adverse weather conditions but once they arrive here local conditions such as temperature, stage of leaf-burst and availability of prey items will influence the timing of breeding. In a mild spring when leaf-burst and caterpillar emergence may occur early, birds will need to start breeding relatively quickly if they are to benefit from the peak availability of food.

Evidence suggests that Pied Flycatchers have responded by laying their eggs earlier. No records of egg-laying in April occurred until 2002 and then in the period 2002-10 a total of eleven first eggs were recorded in April, all laid on 29/30. More recently there has been a rapid acceleration, with 34 records of first eggs in April between 2011-14, the earliest on 24 April in both 2011 and 2014. And in 2011, more than half of all Pied Flycatcher nests at Prion were started in April. For comparison, the Glyn Arthur site in Denbighshire at higher altitude (150-305m AOD) did not record its first egg in April until 2008 and has only recorded five in total.

The cumulative effect at Prion in the period 1988-2016 has been the advancement of the earliest first egg dates by approximately 4.0 days and median first egg dates by 2.5 days (see Figure 2).

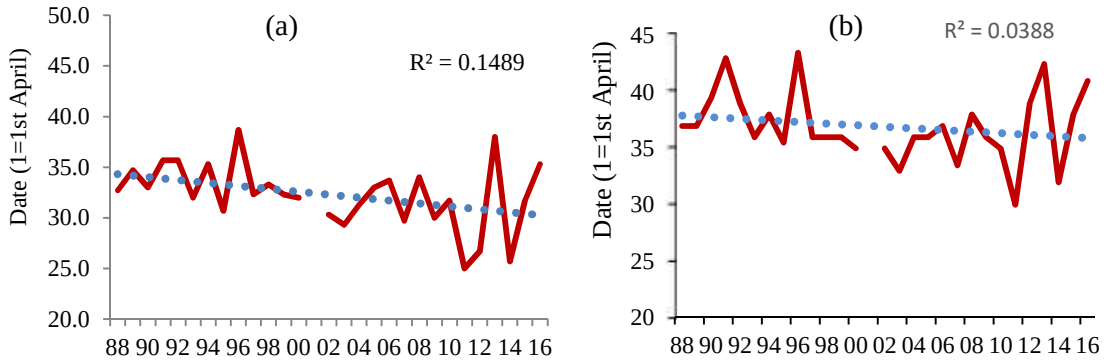


Figure 2: Advancement of first egg dates 1988-2016: (a) Earliest first egg dates (based on the average of the three first eggs for each year); (b) Median first egg dates.

Nationally, first egg dates have advanced by ten days in the period 1967-2014 (Robinson R.A *et al*, 2016). However a glance at the last four years shows how volatile nesting dates can be, with first egg dates in 2014 ten days earlier than in 2016.

Egg productivity

The average size of clutches has remained stable over the study period (see figure 3(a)), suggesting that the fitness for breeding of females has not deteriorated despite the shorter period for recuperation on arrival in Welsh woods in early-nesting years. The trendline for the proportion of eggs that hatch shows only marginal change (figure 3(b)) but that masks two catastrophic years in 2002 and 2012 when hatching success rates were a meagre 64% and 65% respectively. The number of hatched young per nest has fluctuated over the study period (excluding 2002 and 2012) between 5.50 and 6.76. The average for the last four years is 6.46.

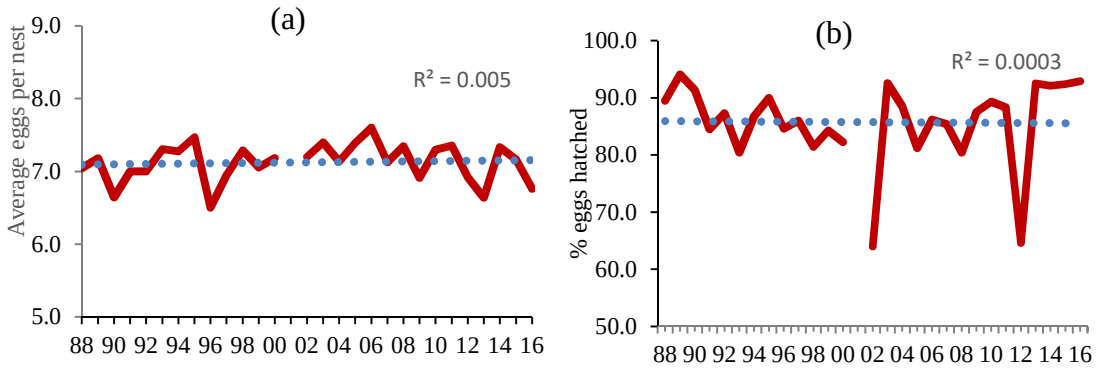
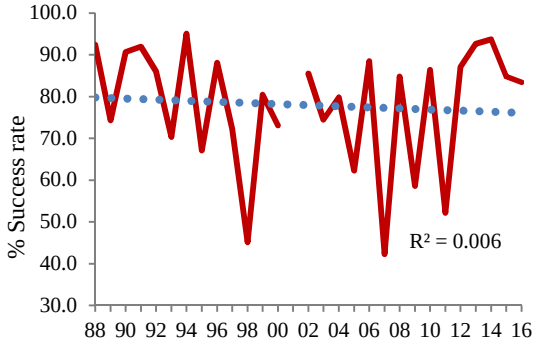


Figure 3: Egg productivity 1988-2016: (a) Average size of clutches per year; (b) Proportion of eggs that hatched each year.

Fledging rates

It is a very different story for fledged young. Looking at the proportion of chicks that manage to fledge, the overall trendline has fallen by 5% and, as figure 4 shows, the period between 1998 and 2011 was very volatile, with success rates of less than 50% on two occasions. So what has caused this decline?



Several factors can lead to the death of chicks. Nests may be predated by weasel, stoat, grey squirrel, wood mouse or great-spotted woodpecker, an event that usually results in the total loss of a brood. The incidence of direct predation of chicks is unpredictable; it accounted for less than 7.5% of chick deaths but spikes in predator activity in some years could cause up to 25% of deaths. There is no discernible trend over the study period.

Figure 4: Success rates of chick fledging, 1988-2016

The commonest cause of chick death is starvation or sickness, averaging 14.6% but with wide variation between years: maximum and minimum values are 52.2% in 2007 and 2.1% in 1988 and the average during the period 1998-2011 was 23.5%. The abundance of the caterpillar crop is one of the key factors; in years of high abundance most adult Pied Flycatchers will find enough food to feed their chicks but in poor years they will struggle. Weather is another factor; periods of wet cold weather can temporarily make it harder for parents to find food even in good years. Conditions in the nest box can become cold and damp and whole broods in the first few

days of life, weakened by a lack of food, often perish. Prolonged spells of wet weather may cause the death of older chicks, even those close to fledging. Third, but least common, the death or absence of a parent leads to reduced provisioning of growing chicks. If the female dies, the male initially continues to feed chicks but invariably fails to provide enough food, leading to the total failure of the brood. Females cope much better with the absence of a male and can raise a full brood successfully but more commonly have partial success with one or more runts dying.

An example of the latter occurred in 2015. Two nests approximately 80m apart, at the edge of a wood, had identical first egg dates, number of eggs and hatching date. At one nest, with an attentive male assisting the female, all seven chicks fledged; at the second, with an absent male, only four chicks fledged (see table 1). The lone female copes initially but as the chicks develop, they become underweight relative to the norm for their age, and the runts successively perish.

Nest	Hatching date	Adults feeding	Day 7		Day 11		Day 13		Fledged young
			Average chick weight	Live chicks	Average chick weight	Live chicks	Average chick weight	Live chicks	
PLV101	31 May	F+M	10.89	7	14.04	7	14.10	7	7
PLV104	31 May	F	10.09	7	9.70	6	11.02	5	4

Table 1: Comparison of chick-rearing between one nest with the male assisting and a second without male support.

Breeding success rates

Analysis of breeding success rates, represented by the average number of fledglings per nest, for the UK compared to Prion shows that Prion performs below the national average in 21 out of 27 years (see figure 5). In the period 1988-2015, the number of fledglings per nest fell below 5.0 in four years for the UK population but in 16 out of 27 years at Prion. Readings below 4.0 fledglings per nest were recorded in seven years at Prion but none for the UK. Clearly, Prion's stable clutch sizes and hatching rates are overshadowed by the larger decline in chick fledging rates.

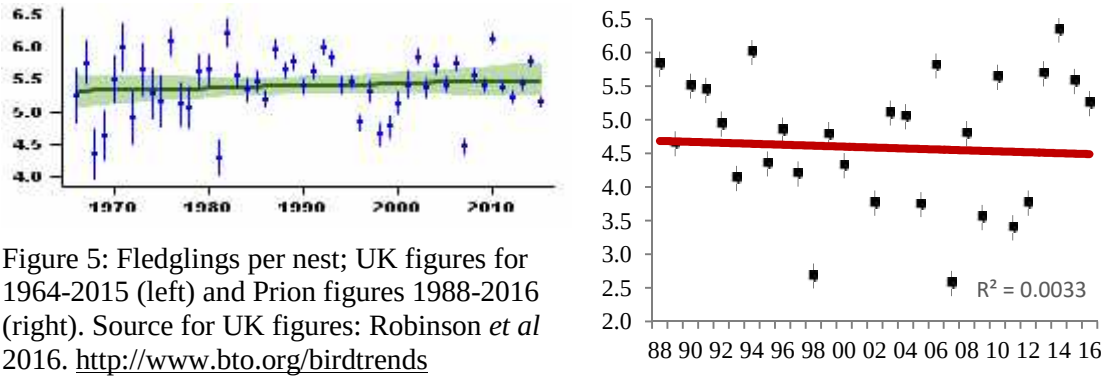


Figure 5: Fledglings per nest; UK figures for 1964-2015 (left) and Prion figures 1988-2016 (right). Source for UK figures: Robinson *et al* 2016. http://www.bto.org/birdtrends

2013-15 account for three of the years when Prion's fledglings per nest were above the national average. The 2013 breeding season got off to a very late start with the earliest first egg date of 8 May and median first egg date of 13 May. The late start meant clutch sizes were smaller (6.6 eggs per nest) but thankfully conditions were perfect: no predation, abundant caterpillar crop and no adverse weather, resulting in a fledging rate of 5.7 chicks per nest. This success was followed by a surge in the number of breeding pairs in 2014 to 33 and in 2015 to 38, laying the foundations for the 2016 season and the record-breaking 50 Pied Flycatcher nests. The total of 50 nests broke the previous record, 39 nests in 1993, by a considerable margin. The season started relatively late, suppressing the average clutch size (6.76 eggs), but breeding success (egg/fledged young) was high, with the total of 262 fledged young comfortably beating the previous record of 209. Is this a one-off event or is there evidence of a more sustained growth in the local population?

Discussion

The poor performance of Prion relative to the UK Pied Flycatcher population seems to contradict the assertion made by Wright *et al* (2004) that little evidence exists to suggest the decline in UK Pied Flycatchers is the result of change in breeding habitat or per capita reproductive success (ie fledglings per nest). Prion failed to deliver 5.0 fledglings per nest for 59% of the study period compared to 14% nationally.

On most occasions when the success rate dropped below 4.7 the breeding population fell in the subsequent year. For example, a very poor season in 1998, with only 2.7 fledglings per nest, was followed by the collapse to just 18 breeding pairs in 1999, the lowest total recorded. The alternative has also been experienced – a high breeding success rate in 2006 (5.8 fledglings per nest) was followed by a surge in the number of breeding pairs (31) in 2007. The apparent connection between the number of chicks fledged one year and the number of nests in the next year is intriguing, and would suggest a closed breeding population. However, the recruitment of fledglings into the breeding population is extremely low. For the whole study period only 1.74% of pulli have returned to breed; in the last ten years, as more adults, particularly males, have been caught, the figure has risen to 3.20% but that is still a tiny fraction. Additionally, the number of new adults joining the population each year exceeds the number of returning adults.

Fluctuations in fledging rates were also checked against adult survival in the following year. In poor years with high chick mortality, it may be expected that adults, under great strain trying to raise their young, may become exhausted and even die, either at the breeding site or on the arduous migration to their winter quarters. However, checks using the adult survival rate provided through the RAS study shows there is no correlation.

If it is not a closed population, could Prion draw on a metapopulation based on the Welsh marches/ Shropshire and Herefordshire? Controls of ringed birds show 79 out of 86 movements are between those areas; it is also noticeable that not a single control has been received from west Wales.

Within such a metapopulation, will there be variation in performance between sites each year? The number of Pied Flycatcher nests at Prion between 2008-16 has been compared with totals for Pandy and Glyn Arthur, two other Merseyside Ringing Group sites with Pied Flycatcher populations (figure 6). All three sites suffered losses between 2008-13, although annually there was no uniformity of change with one or two sites increasing each year until 2013. Since 2013, Pandy has recovered to its 2008 nest total whilst Glyn Arthur has increased only marginally on the 2013 nest count and, compared to 2008, has seen the number of nests fall by 47%. In this context, Prion's increases of 127% since 2013 and 72% since 2008 are exceptional.

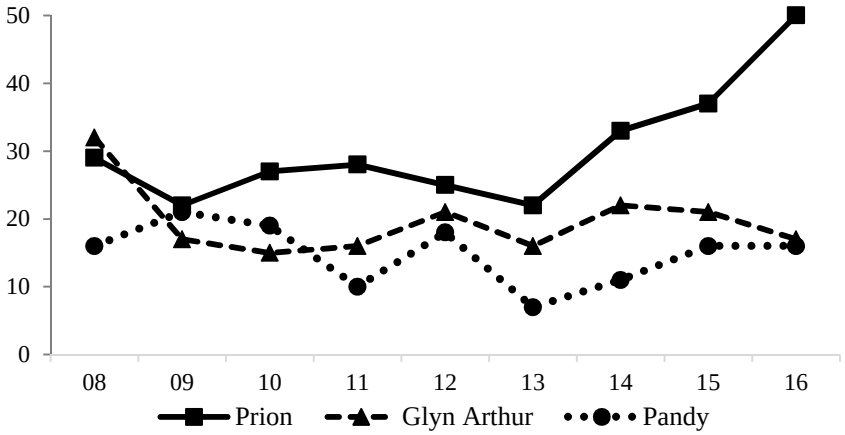


Figure 6: Number of Pied Flycatcher nests recorded between 2008-16 at three MRG sites.

Returning to Prion's past performance, the below-average per capita reproductive success might be explained by the presence of a high proportion of yearling breeders. Various studies, summarised in Lundberg and Alatalo 1992, showed the average clutch size of yearling females was from 0.5 to 0.9 eggs smaller than that of older females, although in a study in Cumbria the difference was only 0.3 eggs and it disappeared if clutch sizes were standardised by the laying date. The smaller clutch sizes may reflect the avoidance of high reproductive costs at an early age or the capacity of inexperienced yearling birds to raise offspring. At Prion a sample analysis of breeding adults in the ten-year period 2007-2016 appears to show a weighting in favour of mature breeders (table 2), suggesting the composition of the population should not be a key factor affecting reproductive success.

	2+ years	Yearlings	Not aged
Females	177 (60%)	112 (38%)	6 (2%)
Males	142 (62%)	82 (36%)	5 (2%)

Table 2: Age of breeding adult Pied Flycatchers caught at Prion between 2007-2016

A significant proportion of Pied Flycatchers of both sexes do not breed in their first season (Lundberg and Alatalo 1992; Both *et al* 2017). Using the known age at first breeding of returning pulli at Prion as a proxy, 56% of females and 45% of males bred in their first year. Analysis of birds ringed elsewhere as pulli and controlled at Prion shows 52% of females but only 22% of males bred in their first year. However the delayed start to breeding does not impact on breeding performance in later years.

There is no evidence to indicate that habitat change has influenced breeding success. The habitat shows little sign of deterioration; the grazing regime in the upper valley remains unchanged and forestry management, including the retention of dead trees, has been consistent throughout the study period. Plotting the distribution of nest boxes most often used by Pied Flycatchers at Prion clearly demonstrates a preference for woodland with low ground-cover plants. In part that may reflect a foraging strategy which includes up to 15% of prey caught on the ground (Edington and Edington 1972). Competition from tit species for nest boxes in areas with shrub cover may also reduce their presence in those areas. The colonisation of the understorey in the lower valley by shrubs, particularly holly and laurel, is patchy and understorey with only low ground-cover plants is available throughout the wood.

Natural factors appear to be the driving force. Adults appear to have adapted well to the impact of climate change, maintaining both clutch size and hatching success rates, but an early start is not a guarantee of success. For example in 2011, the only year in which the median first egg date fell in April (30), the breeding success (fledglings per nest) was 3.4, the third-lowest for the study.

Chick death is the key factor, particularly starvation/sickness which averaged 23.5% during the period 1998-2011. The two years with the lowest rates of breeding success (1998 and 2007) coincide with very wet weather at a crucial time in the season. Thirty years of monitoring at Prion has also demonstrated the very localised nature of weather-related impacts. For example, in 2007, prolonged rainfall over a three-day period 26-28 May, combined with daytime maximum temperatures below 15°C, had a devastating effect. Chick mortality attributed to weather-related deaths was 37.9% in the upper valley compared to 63.6% in the lower valley (Coffey 2007) whilst at Pandy, 29km away, less than 7% died.

A run of three good breeding seasons, plus an adequate supply of nest-boxes in good condition, enabled the record 50 Pied Flycatcher nests to be achieved in 2016. Only since 2007 has Prion had enough nest boxes in the right condition and location to sustain an expanding local population. The fact that the size of the breeding population continued to decline after more boxes were erected demonstrates the significance of natural factors affecting chick mortality.

However if the boxes had not been added, the recovery of the Pied Flycatcher population since 2013 could not have been accommodated – and, worryingly, would never have been recorded. It is impossible to gauge how many more pairs of Pied Flycatchers might have used extra boxes in earlier years, possibly leading to stronger recoveries similar to that observed from 2014-16. It also raises the question, at sites where the Pied Flycatcher population is declining, of whether the availability of nest boxes, in good condition, is a significant limiting factor. The study by Vilka (2003) demonstrated at long-running nest box sites that replacement of old boxes for new led to an increase in nesting.

The study has demonstrated how a few poor breeding seasons can lead to a significant collapse in the local population but also how quickly the population can rebuild if the infrastructure is in place. The larger population may be sustained, albeit with plenty of bumps along the way, but much more analysis of the dynamics of local Pied Flycatcher populations is required.

Acknowledgements
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