

SITE FIDELITY AND SURVIVAL AMONG BLUE AND GREAT TITS MAKING USE OF SUPPLEMENTARY FEEDING SITES AT WICKEN FEN

Since 2003/4 the Wicken Fen Ringing Group has been providing supplementary food (peanuts, mixed seeds and nyger seed) in multiple feeders at between one and three sites on the Fen, out of the immediate breeding season. The initial aim of this feeding programme was to increase the capture success rates particularly over the winter period since prior to the introduction of supplementary feeding, captures on the Fen in the months December–March were invariably small (10-20 birds per session) occasionally fewer than 10 birds in a day.

Wicken Fen is predominantly open marsh, consisting of sedge fields and reedbed, there is one area of wet woodland and c20% is scrub (alder buckthorn/hawthorn); once the berry crop has been devoured there is little natural food to keep birds on the site over winter.

The expected species were attracted by supplementary feeding, prominent among them were Great and Blue tit and the resulting increased contacts have provided valuable information from the retrap data concerning the site fidelity of these birds on the Fen and especially their survival.

METHODS

Since 2004 the increased volume of ringing activity at Wicken Fen has been around two visits a week, each of around five to six hours and similar amount of net in most visits depending on circumstances such as prevailing weather conditions. During the study period one of the three ringing sub-sites (H) was used preferentially but data was subsequently collected at all three sub-sites (B, F & H). Over the three year study period (2005-07) the number of birds handled each month (ringed and

retrapped) was c100 of each species in Sept-Feb and c50 in June-Aug with smaller numbers in April and mainly pulli, ringed in May.

The individual ringing and retrap records of Great and Blue Tits (predominantly first-year birds at the time of ringing) for the years 2005-2007 were stored on IPMR and the data examined to determine survival in three month periods for the first year, and thereafter in twelve month periods.

These data have been used to calculate the percentage survival of cohorts by month of ringing and allowed analysis to determine whether survival was consistent from month to month and year to year. In addition these data have been analysed to determine the extent to which individuals roam across the area of the Fen (between feeding stations).

RESULTS

1. SURVIVAL

The most widely used statistical analysis for calculating survival is the computer programme MARK (White & Burnham 1999). The programme allows the estimation of survival rates and between-site movement probabilities in a way that takes into account the "hidden" movements that were not observed because the bird was not captured in that period (Green, R.E. pers comm). This paper, however, presents a simpler analysis, of survival measured by calculating the percentage known to survive in the three month periods.

The percentage survival figures for the years 2005-2007 are presented in tables 1-3 (Blue Tit) and 4-6 (Great Tit) based on the month of ringing (each being called a cohort in the text). In months where the number of birds per month is low <8 these data have not been included in the calculation of the annual mean survival percentages and the row in the table is highlighted to indicate this. At the time of writing (2010) barely

three years have elapsed since 2007 so longevity for that year is always going to be reduced in comparison with 2005 and 2006.

BLUE TIT

Table 1: Blue Tit percentage survival of first- year birds ringed in 2005

MONTH	No ringed	3 months	6 months	9 months	Year	2 years	3 years
JANUARY	26	69	58	58	54	23	12
FEBRUARY	23	26	17	13	13	0	0
MARCH	24	38	38	38	21	17	8
APRIL	3	66	66	66	0	0	0
MAY	0	0	0	0	0	0	0
Pulli	46	26	26	15	7	4	3
JUNE	41	44	44	24	7	2	0
JULY	21	66	52	24	18	4	0
AUGUST	11	64	64	45	45	27	9
SEPTEMBER	36	36	22	14	11	3	0
OCTOBER	47	36	17	11	11	4	2
NOVEMBER	41	41	24	24	20	15	5
DECEMBER	36	39	22	25	22	8	0
MEAN		46 / 4.7	36/ 5.6	28/4.8	22/4.9	10/ 3.0	3

Means do not include April/May or pulli

Table 2 Blue Tit percentage survival of first- year birds ringed in 2006

MONTH	No Ringed	3 months	6 months	9 months	Year	2 years	3 years
JANUARY	34	26	21	21	21	6	6
FEBRUARY	23	9	9	9	5	0	0
MARCH	15	13	13	13	7	6	0
APRIL	6	0	0	0	0	0	0
MAY	0	0	0	0	0	0	0
Pulli May	7	29	29	14	14	0	0
Pulli June	6	0	0	0	0	0	0
JUNE	7	43	29	14	14	14	0
JULY	32	69	44	19	16	3	3
AUGUST	18	72	39	28	28	22	11
SEPTEMBER	54	43	19	13	11	4	4
OCTOBER	35	29	14	11	11	3	3
NOVEMBER	58	40	22	21	21	14	2
DECEMBER	24	46	25	21	17	0	0
MEAN		39	24	17	9	6	4

*Means do not include Apr/May or pulli

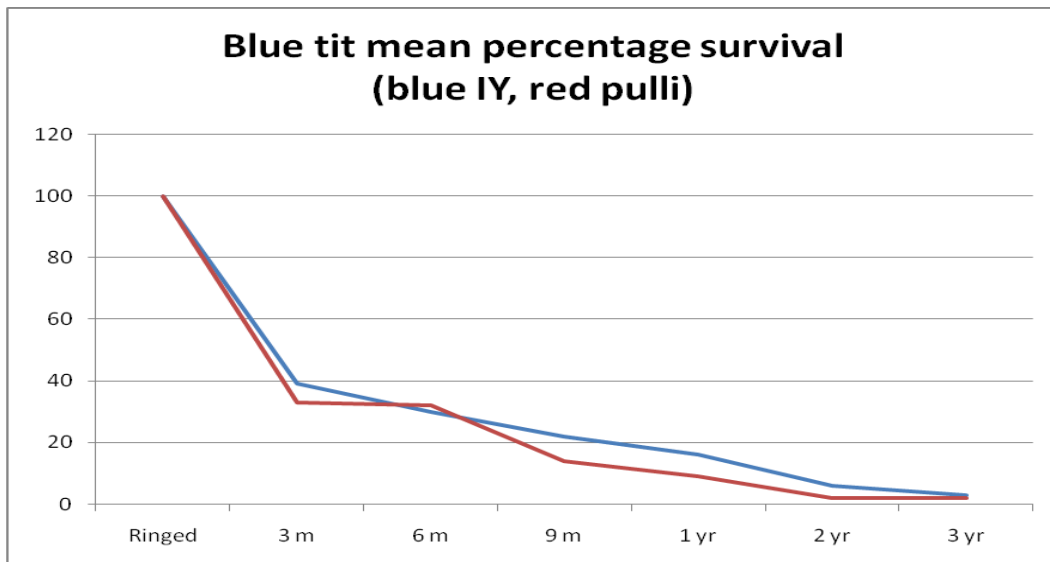
Table 3: Blue Tit percentage survival of first- year birds ringed in 2007

MONTH	No ringed	3 months	6 months	9 months	Year	2 years	3 years
JANUARY	29	24	24	24	24	4	3

FEBRUARY	24	4	4	4	0	0	0
MARCH	14	14	14	7	1	0	0
APRIL	3	33	33	33	33	0	0
MAY	2	50	50	50	50	0	0
Pulli	75	41	37	13	11	0	0
JUNE	34	50	44	23	12	6	0
JULY	20	65	60	40	40	20	0
AUGUST	14	57	36	21	14	7	0
SEPTEMBER	34	56	32	21	18	3	0
OCTOBER	29	34	7	7	3	0	0
NOVEMBER	40	38	28	28	28	5	0
DECEMBER	19	32	32	32	32	5	0
MEAN		34	30	21	21	5	1

*Means do not include Apr/May or pulli

Figure 1 Composite of Blue Tit, first year and pulli, mean monthly survival based on all three years (non highlighted months)



ADULTS

2005

Only six birds were ringed as adults and of those only one was retrapped after three months (it was retrapped six and nine months later).

2006

18 adults ringed: Jan 10, Feb 5, Apr 1, June 1, Aug 1. One bird ringed in January was alive a year later. None of the others was recorded again.

2007

Three birds were ringed as adults: 2 in February and 1 in Mar, none were retrapped.

Table 4: Blue Tit mean (plus standard error) monthly percentage survival first- years birds 2005-07

MONTH	No ringed	3 months	6 months	9 months	Year	2 years	3 years
January	30 +/- 2.3	40 +/-14.7	34 +/- 11.9	34 +/-11.9	33+/-10.5	11 +/- 6	7 +/- 2.6
February	23 +/- 0.3	13 +/-6.7	10 +/- 3.8	9 +/-2.6	6 +/- 3.8	-	-
March	18 +/- 3.2	22 +/- 8.2	22 +/- 8.2	19 +/- 9.5	10 +/- 5.9	8 +/- 5	3 +/- 2.7
*Pulli	45 +/-17.9	27 +/- 7.5	26 +/- 6.4	15 +/- 0.3	9 +/- 1.2	1 +/- 1.3	1 +/- 1
June	27 +/-10.4	46 +/- 2.2	39 +/- 5.0	20 +/-3.2	11 +/- 2.1	7 +/- 3.5	-
July	24 +/- 3.8	67 +/- 1.2	52 +/- 4.6	28 +/- 6.3	25 +/- 7.7	9 +/- 5.5	1 +/- 1
August	14 +/- 2	64 +/- 4.3	46 +/- 8.9	31 +/- 7.1	29 +/- 9.0	19 +/- 6.0	7 +/- 3.4
September	41 +/- 6.4	45 +/- 5.9	24 +/- 3.9	16 +/- 2.5	13 +/- 2.3	3 +/- 0.3	1 +/- 1.3
October	37 +/- 5.3	33 +/- 2.1	13 +/- 3.0	10 +/- 1.3	8 +/- 2.7	2 +/- 1.2	2 +/- 0.9
November	46 +/- 5.8	40 +/- 0.9	25 +/- 1.8	24 +/- 2.0	23 +/- 2.5	11 +/- 3.2	2 +/- 1.5
December	26 +/- 5.0	39 +/- 4.0	26 +/- 3.0	25 +/- 3.5	24 +/- 4.4	4 +/- 2.3	

Figures for April & May not included due to small sample size
 Highlighted figures reflect survival into the next breeding season.

The table, and the equivalent for great tit, can show some high SEs due to the small sample size(n=3)

Summary Blue Tits

First years. The tables show that for first-year birds ringed some months survival is high, such successful cohorts can be seen in January 05 – the most successful cohort - and August 06. The 26 birds ringed in January 2005 showed surprising robustness with 54 % still known to be alive a year later, 23% two years later and 12% three years later.

By contrast unsuccessful cohorts (where more than 5 birds were ringed) were April 06, February 07, and probably October 07.

In general over all three years first-year Blue Tits ringed in August showed the highest survival, those ringed in March the lowest (Fig 2), but it is important to note that for birds ringed in March to contribute to

the breeding population survival for 3 months is all that is required whereas for birds ringed in August a minimum of 9 months is required.

Pulli: pulli showed low long-term known survival. No pulli from 2006 and 2007 showed survival beyond a year. One possible explanation is that these birds dispersed more readily than the first year ringed birds, indeed the first year ringed birds might have arrived at Wicken as a result of post-natal dispersal.

Adults: adults (and therefore unknown real age beyond 1 year) showed the expected mortality effect of a short-lived species in that of 27 birds ringed in 2005-07 only one was known to be alive a year later.

GREAT TIT

Table 5: Great tit: first-year percentage survival 2005

MONTH	No ringed	3 months	6 months	9 months	Year	2 years	3 years
JANUARY	9	44	33	33	33	23	11
FEBRUARY	10	10	10	10	10	0	0
MARCH	21	29	29	29	0	0	0
APRIL	5	20	20	20	20	0	0
MAY	2	0	0	0	0	0	0
Pulli	51	22	20	14	12	8	4
JUNE	14	21	14	7	0	0	0
JULY	20	75	75	45	35	25	5
AUGUST	4	50	25	25	25	25	0
SEPTEMBER	29	48	38	17	14	7	0
OCTOBER	32	56	47	28	28	19	13
NOVEMBER	7	86	14	14	14	14	0
DECEMBER	3	66	33	33	33	0	0
MEAN		41	27	24	17	9	2

Means do not include April/May August or December or pulli

Table 6: Great tit: first-year percentage survival 2006

Month	No Ringed	+3 months	+6 months	+9 months	+ year	+2 years	+ 3 years
JANUARY	9	0	0	0	0	0	0
FEBRUARY	21	10	10	5	5	0	0
MARCH	12	8	8	8	8	0	0
APRIL	11	0	0	0	0	0	0
MAY	0	0	0	0	0	0	0
Pulli May	22	37	27	18	14	0	0

Pulli June	17	41	35	24	12	0	0
JUNE	4	50	50	50	25	25	0
JULY	30	73	56	40	30	13	7
AUGUST	14	71	50	50	43	21	14
SEPTEMBER	31	48	42	32	32	7	0
OCTOBER	34	53	41	38	38	3	3
NOVEMBER	17	35	29	29	29	12	0
DECEMBER	8	75	63	63	34	13	13
MEAN*		37	30	27	21	7	3

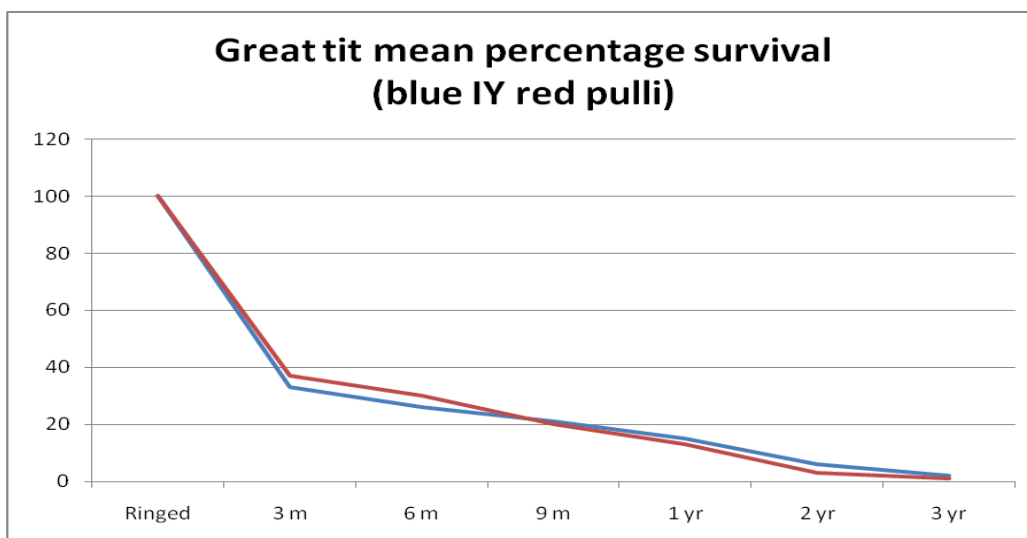
*Means do not include May/June or pulli

Table 7: Great tit: first-year percentage survival 2007

	No Ringed	+3 months	+6 months	+9 months	+ year	+2 years	+ 3 years
JANUARY	12	25	17	17	17	8	8
FEBRUARY	17	24	24	24	12	6	0
MARCH	17	12	12	6	0	0	0
APRIL	4	75	75	75	50	0	0
MAY	0	0	0	0	0	0	0
Pulli	113	44	36	22	12	4	0
JUNE	13	38	38	24	15	0	0
JULY	16	50	31	0	0	0	0
AUGUST	9	33	11	11	0	0	0
SEPTEMBER	36	47	25	22	22	6	0
OCTOBER	28	18	11	4	4	4	0
NOVEMBER	8	50	38	11	11	0	0
DECEMBER	3	33	0	0	0	0	0
MEAN*		33	21	12	8	3	-

*Means do not include Apr/May December or pulli

Figure 2 Composite great tit mean survival based on all three years (non highlighted months).



ADULTS

2005

Seven birds ringed as follows: Jan 1, Feb 2, Mar 2, Oct 1. Three with remarkable longevity - ringed Feb - one alive 1yr 11 months later, one 4 years 3 months, one ringed Oct alive 3 yrs 3 months later.

2006

11 ringed as follows: Jan 2, Feb 3, Mar 1, Apr 5. Of these an April ringed bird was known to be alive 9 months later, none of the others were recorded again.

2007

Five birds ringed as adults as follows: 3 in January and 2 in September; none were retrapped.

Table 8. Great tit mean monthly percentage survival first- year birds all years 2005-07 combined

MONTH	No ringed	3 months	6 months	9 months	Year	2 years	3 years
January	10 +/-1	23 +/-12.8	17 +/- 9.5	17 +/-9.5	17 +/-9.5	10 +/- 6.7	7 +/- 3
February	16 +/- 3.2	15 +/- 4.7	15 +/- 4.7	13 +/- 5.7	9 +/- 2.1	2 +/- 2	-
March	17 +/- 2.6	16 +/- 6.4	16 +/- 6.4	14 +/-7.4	3 +/- 2.7	-	-
*Pulli	68 +/- 23	35 +/- 6.6	29 +/- 4.7	19 +/- 2.5	12 +/-0.3	4 +/- 2.2	1 +/- 1.3
June	10 +/- 3.2	36 +/- 8.4	34 +/- 10.6	27 +/-12.5	13 +/-7.2	8 +/- 8.3	-
July	22 +/- 4.2	66 +/- 8.0	54 +/-12.8	28 +/-14.3	22 +/-10.9	13 +/-7.2	4 +/- 2.1
August	9 +/- 2.9	51 +/- 11	29 +/- 11.4	29 +/-11.4	23 +/-12.5	15 +/-7.8	5 +/-4.7
September	32 +/- 2.1	48 +/- 0.3	35 +/- 5.1	24 +/- 4.4	23 +/-5.2	7 +/- 0.3	-
October	31 +/- 1.8	42 +/-12.2	33 +/- 11.1	23 +/-10.1	23 +/-10.1	9 +/- 5.2	6 +/-3.9
November	11 +/- 3.2	57 +/- 15.2	27 +/- 7	18 +/- 5.6	18 +/- 5.6	9 +/- 4.4	-
December	5 +/- 1.7	58 +/- 12.8	33 +/- 19.1	33 +/-19.1	22 +/-11.2	4 +/- 4.3	4 +/- 4.3

Highlighted figures reflect survival into the breeding season.

SUMMARY: GREAT TITS

First years: Exceptional survival from January 2005 with 11% known to be alive in 2008 and October 2005 with 13% known to be alive in 2008. In August 2006 14% survived for three years and in December 2006 13% survived for up to 3 years. The year 2007 proved to be a poor year with only notable survival 8% from the January catch. This is reflected in the

means: the 9 month survival mean for 2007 is half that of the previous two years.

Table 8 shows that birds ringed July-December showed greater survival to breeding season than birds ringed January-March.

Pulli: slightly higher long term survival than Blue tits (12:9) and higher and longer term from the 2005 than 2006 and 2007.

Adults: of 23 birds ringed most were not caught again, however, three exceptional birds in 2005 were known to be alive

2. SITE FIDELITY

Individuals unrecorded for long periods

In two short-lived, largely sedentary species such as the blue and great tit it is reasonable to expect that with fairly intensive ringing at a site where supplementary feeding takes place each individual present will be retrapped with some regularity during its lifetime providing it remains within the area. However, surprisingly in a number of cases there were long gaps between recaptures, sometimes as long as two years (blue tit 8), for extreme examples see table.

BLUE TITS

	RINGED	RETRAP1	RETRAP2	RETRAP3	RETRAP4	RETRAP5	RETRAP6	RETRAP7
1	Jan 05	Feb 06	Jan 07	Feb 07 x2	Jan 09	Mar 09		
2	Jun 05	July 05	Jan 08					
3	Nov 05	Nov 07						
4	Dec 05	Dec 05x3	Jan 06 x2	Dec 06	Feb 08			
5	Dec 05	Dec 07						
6	Aug 06	Sep 06 x2	Nov 06	Dec 06x3	Oct 07	Nov 08	Feb 09	
7	Nov 06	Feb 07	Mar 07	Apr 07	Dec 07	Feb 09		
8	Nov 06	Dec 06	Jan 07 x3	Feb 07	Oct 07	Nov 07	Dec 08	Jan 09
9	Nov 06	Dec 06	Oct 07	Nov 07	Jan 09			

GREAT TITS

	RINGED	RETRAP1	RETRAP 2	RETRAP3	RETRAP4	RETRA P5	RETRAP 6	RETRAP7
1	June 05	May 07	Apr 08					

2	Oct 05	Oct 05	Oct 05	Nov 05	Dec 06	Feb 07		
3	Aug 05	Oct 05	Oct 05	Nov 05	Feb 06	Mar 06	Dec 06	Apr 08
4	July 05	Feb 07	Apr 07					
5	Oct 05 x4	Nov 05x2	Jan 06 x2	Feb 06 x2	Apr 06 x2	Dec 09	Jan 10	
6	Dec 05	Apr 07	Apr 07					
7	May06*	Mar 08						
8	Nov 06	Nov 06	Mar 07	Nov 08				
9	Mar 06	Mar 06	Nov 07	Dec 07	Jan 08			

*Ringed as a nestling

There were many instances of individuals not caught for a period of at least a year. This raises the question where were these individuals between captures? Were they present on the Fen but eluded the ringers or were they elsewhere, such as in the village, and visited the Fen only occasionally. In a population where birds can 'disappear' for periods of a year or sometimes two or more this may have implications for population calculations although as a proportion of the total population this sort of disappearing is recorded in less than 3%

Patterns of survival from groups of birds ringed on the same day.

Scenario 1. An exceptional catch on July 30th 2005 yielded individuals of both species that were part of a mixed flock and were both long lived and remarkably site faithful as shown in the table below (whole numbers NOT percentages):

Blue tit

RINGED	3 MONTHS	6 MONTHS	9MONTHS	YEAR	18 MTHS
8	7	3	3	3	2

Great tit

RINGED	3 MONTHS	6 MONTHS	9MONTHS	YEAR	2 YEAR	3YEAR
8	8	8	7	5	4	1

Scenario 2. On October 19th 2005, similar numbers of blue and great tit ringed with contrasting fortunes as all the great tits ringed were

recaptured at least 6 months later and 3/5 over a year later while, of the similar number of Blue tits ringed, only one bird remained for at least 3 months and none beyond that: shown in the tables below (whole numbers not percentages)

Blue tit

RINGED	3 MONTHS	6 MONTHS	9MONTHS	YEAR	2 YEAR	3YEAR
6	1	0	0	0	0	0

Great tit

RINGED	3 MONTHS	6 MONTHS	9MONTHS	YEAR	2 YEAR	3YEAR
5	5	5	3	3	2	2

Did individuals move between the three ringing sites on the Fen?

Throughout the study period ringing took place at three different sites within the Fen (H, B & F see map) although rarely simultaneously. Site H was used more extensively and was closest to Wicken Village. Site B, on the western edge of the Fen, was approximately 1km from site H and site F, largely reedbed, was 1.5 km from site H. A circuit of the three sites would cover c3.5-4km.

Blue Tits

Blue tits were more sedentary although movement between the two sites on the northern edge of the Fen B & H was not uncommon there were noticeably fewer records of individuals caught moving between F & H. Some exceptions:

V496032 ringed Aug 07 retrapped until Apr 10: H,F,H,H,H,F,F,F,F

Great Tits

Great tits showed a greater tendency to roam around the Fen, exceptional individuals are listed below.

T492838 same day retrap from H to F never seen again.

T940459 ringed F Nov 06 retrapped until Mar 08: F,H,F,H,H,H,H,F,F,H,H,H,H,H,H,F

T940480 ringed F Dec 06 retrapped until Apr 08: H,H,H,H,F,H,H,F,F,F,H,H

T490557 ringed F Apr 07 retrapped until Mar 09: F,M,H,H,B,H,F,F,F,F,F,H,F,H,F,H,F,F,H,H

T941031 ringed B Apr 07 retrapped until Mar 09: B,F,F,H,H,F,H,F,F,K,F,F,H,H,F

DISCUSSION

Survival estimates

Several authors have attempted to analyse survival rates in tits, usually from ringed nestlings. Of the two species more data are available for Great Tits which have been the subject of intensive studies by for example Perrins in Oxford (1965) and Dhondt in Sweden (1979). Both these studies, in woodland an optimal habitat compared to Wicken Fen, suggested that by September only 22% of the birds ringed as nestlings survived, the Wicken Fen figures are higher c 30%. Dhondt estimated a mortality rate of 45% per month for the first 2.5-3 months after fledging, and a rate of 5% from October until the following breeding season by which time he estimated 15% of the nestlings survived, compared with Wicken Fen actual figures of 12-13% for Great Tit and 11% for Blue Tit. Despite ecological, temporal and geographical differences these figures seem remarkably similar.

Dhondt quoted an adult survival rate of c50% in Great Tits. At Wicken Fen the figures (survival from year 1 to year 2) are identical for both species at 43%. The advantage of the Wicken Fen study is that because the data cover a six year period, so longevity was measured rather than estimated.

Between-year differences

In the case of both Blue Tit and Great Tit the between -year differences were generally minimal, the rate of population decline being consistent year on year for both species (small sample n =3). However, Blue Tit pulli

had a bad year in 2005 when only 7% survived to the following breeding season and an exceptional year following in 2006 when survival doubled to 14%. Since these small birds are highly susceptible to changes in conditions any year on year changes are likely to be the result of such things as weather conditions.

Between-month differences – significant survival

The important period of survival is to remain alive at the following breeding season which becomes the definition of survival success. Birds ringed in August must survive for a minimum of 9 months to be part of the breeding population whereas birds ringed in January need survive only 6 months and birds ringed in March need survive only 3 months. Survival success highlighted in Tables 4 and 8 suggest a mean for Blue Tits of 20% +/- 2.6 and for Great Tits a remarkably similar 20% +/- 2.0. This suggests a mortality by the breeding season among birds ringed as first year and/or pulli of 80% (not allowing for emigration/dispersal).

The effects of dispersal

Post-natal dispersal is a known strategy in territorial birds, the purpose being to avoid in-breeding. Limitation of technology means that few studies to date have been able to quantify the exact extent of post-natal dispersal (what proportion of the new generation leave their natal area), however, authors agree that dispersal appears to take place within a short time after fledging. Factors such as differing climatic conditions, habitat fragmentation and feeding sites are likely to vary both temporally and spatially; so that at Wicken Fen, compared with the Oxford and Swedish studies there are particular differences. The two most significant and site-specific factors are that a) within the site the proportion of suitable habitat (scrub and woodland) for tits is small > 20%, and b) the Fen and the adjacent village of Wicken are an oasis in a sea of intensive arable farmland so with the exception of the nearby hamlet of Upware the closest suitable habitat is approximately 4-5 km distant. This distance,

combined with the habitat fragmentation in a stark open landscape, is a significant problem that is likely to discourage dispersal and/or immigration. In this study dispersal remains an unknown and possible confounding factor to survival figures.

Immigration and the late arrivals

What was the source of birds ringed late in the winter and early spring and therefore presumed immigrants? Given the extent of ringing activity and the limitations of habitat in the surrounding geographical area, it might be expected that almost all individuals in the population would be caught and ringed before the turn of the year, yet each year around 30-40 new birds of both species were ringed in February and March. Possibly this was a result of birds that had been 'living' in the village of Wicken, or had dispersed there, equally it is possible that these birds were present on the Fen but normally less reliant on supplementary feeding. In both cases their presence could be the result of a decline in other food sources. Equally possible is real immigration although, as for dispersal, this would involve a journey of more than 2km over inhospitable open land.

More surprising were the birds that re-appeared as much as a year after their last capture. This could be explained by them being driven to the supplementary food only when all else failed. These re-appearing birds also complicate the dispersal/immigration factor since it might be argued that they dispersed and then immigrated (or returned) a year later. In all cases despite our ringing sites covering a reasonable proportion of the ideal tit habitat on the Fen it could be that these individuals were holding territories sufficiently far from the main ringing sites that they visited the feeders only rarely and *in extremis*.

Dhondt, Andre A. (1975) Summer Dispersal and Survival of Juvenile Great Tits in Southern Sweden. *Oecologia* 42 139-157.

Perrins, C.M. (1965) Population fluctuations and clutch size in the Great Tit. *J. Anim. Ecol* 34: 601-647.

White, G.C. and K. P. Burnham. 1999. Program MARK: Survival estimation from populations of marked animals. *Bird Study* 46 Supplement, 120-138.