Title	**Breeding ecology of Blue Tits**
General metadata	
Abstract	European Blue tits (*Cyanistes caeruleus)* time reproduction so the period for rearing chicks is synchronized with the peak of abundance of caterpillars, most of which feed on young leaves of deciduous trees. A long-term study at Silwood Park aims to understand the extent to which a mismatch between breeding phenology and prey availability affects a wild population of these birds. Hundreds of nest boxes and thousands of oak trees distributed across the campus' woodlands are monitored annually since 2002 to track the breeding activity of nesting tits and record the time of emergence of new oak leaves.
Keywords	Mismatching phenology, food chain, Laying date
Is this part of a larger study?	Yes, these observations are part of the long-term monitoring of oaks and blue tit matching phenology study
Individual: Primary contact	Julia Schroeder
Position	Senior lecturer in Ecology and Evolution
Organization	Imperial College London, Department of Life Science
Address	Buckhurst Road, Ascot, SL5 7PY
Phone	+44 (0)20 7594 9086
Email	julia.schroeder@imperial.ac.uk
Web address	http://www.imperial.ac.uk/people/julia.schroeder
Individual: Associated parties	Catalina Estrada Montes
Position	Ecological Analyst and Facility Manager
Organization	Imperial College London, Department of Life Science
Address	Buckhurst Road, Ascot, SL5 7PY
Phone	+44 (0)20 7594 2217
Email address	c.estrada@imperial.ac.uk
Funding	Imperial College London, Department of Life Science NERC (NE/E017487/1) to I. Owens 2007-2011
Permits	Natural England License Number 20081222/3 to Ian Owen (?) Home office PPL 7009092 (2016-2021) & PPL (2021-2026) to Julia Schroeder
Data set status and accessibility	
Status	Ongoing
Latest update	December 2023
Latest archive date	December 2023
Metadata status	December 2023
Accessibility	
Storage location and medium	"Research group space: SilwoodLTE", Imperial College London, ICT department
Usage rights	Open access

<table>
<tr><td>Metadata</td><td>SPI-birds data hub (spibirds.org/en)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Geographic metadata</td><td></td></tr>
<tr><td>Geographic description</td><td>The study site is Silwood Park Campus from Imperial College London, Buckhurst Road, Ascot, Berkshire SL5 7PY, United Kingdom. Silwood Park campus, with about 70 ha, contains ancient woodlands and few-decades-old oak-dominated woodlands. Study oak trees have been set across the campus woodlands, which are classified as W10a, W10e and W16a using the National Vegetation Classification.
Silwood Park experiences an average total annual rainfall of 698 mm with little seasonal pattern. Mean hourly temperature is 10.2 ºC with mean max of 23 ºC in July and mean min of 1.4 ºC in January (Silwood weather station 1987-2021 www.imperial.ac.uk/silwood-park/research/field-experiments/silwood-weather/).</td></tr>
<tr><td>Bounding coordinates</td><td>General for Silwood Park.</td></tr>
<tr><td>Latitude</td><td>51.411</td></tr>
<tr><td>Longitude</td><td>-0.647</td></tr>
<tr><td>UK National grid</td><td></td></tr>
<tr><td>Square</td><td>SU</td></tr>
<tr><td>Easting</td><td>94196</td></tr>
<tr><td>Northing</td><td>68866</td></tr>
<tr><td>Temporal metadata</td><td></td></tr>
<tr><td>Temporal description</td><td>Breeding phenology study started in 2002. Missing data for season 2014 because of a gap in project leadership and 2020 because of Covid Pandemic lockdown regulations.</td></tr>
<tr><td>Begin</td><td>2002</td></tr>
<tr><td>End</td><td>Ongoing</td></tr>
<tr><td>Taxonomic metadata</td><td></td></tr>
<tr><td>General Information</td><td></td></tr>
<tr><td>Taxonomic level: Order</td><td>Passeriformes</td></tr>
<tr><td>Taxonomic level: Species</td><td>Table: NAMESP
<table>
<tr><th>Species</th><th>Common name</th><th>Species code (British Trust of Ornithology)</th></tr>
<tr><td>Cyanistes caeruleus</td><td>Blue Tit</td><td>BLUTI</td></tr>
<tr><td>Parus major</td><td>Great Tit</td><td>GRETI</td></tr>
<tr><td>Periparus ater</td><td>Coal tit</td><td>COATI</td></tr>
<tr><td>Sitta europaea</td><td>Nuthatch</td><td>NUTHA</td></tr>
</table></td></tr>
<tr><td>Methods metadata</td><td></td></tr>
<tr><td>General experimental design</td><td>There is a network of woodcrete nest boxes across the campus' woodlands used to study the breeding phenology of blue tits. Most boxes have a small entrance (26 mm) but two of the woodlands have also a set of boxes with a larger entrance (32 mm). Boxes with larger entrances can be used by Great Tits and all nest boxes are occasionally occupied by Nuthatches and Coal Tits. Nest boxes have a unique name with a letter and a number. Letters of boxes of the same entrance size and within the same woodland have the same letter (also known as territory). The Number of nest boxes have varied throughout the study. Nest boxes with letters A-H were erected in 2001 and those J & K in 2004 (Henderson_UGthesis_2005). Nest boxes with larger entrance (X & GA) were</td></tr>
</table>

<table>
<tr><td></td><td>added in 2009 (Bell_PhDThesis_2014). Several have been excluded from the experiment due to the sale of campus land or due to unknown reasons (information loss), like all nest boxes in territory K. Typically nest boxes are moved to a neighbour tree when the host tree is damaged or fallen. In 2022 breeding season there were 224 active nest boxes, 176 boxes have a small entrance (26 mm) that exclude Great Tits and 48 have a larger entrance (32mm).

The specific location and detailed information of when nest boxes have been in or out of the study can be found in table: Nextboxes_location.csv</td></tr>
<tr><td>Data collection</td><td>1. Data from 2015
Extracted from: Lopera Doblas (2017) Field Season Protocol followed since 2015 -handbook.pdf

Regular visits to nest boxes start on 1st April (day 1). Monitoring aims to record the stage of nest building, the date when first egg is laid, number of eggs and successful chicks fledging a nest.

Females and males breeding in nestboxes are captured, measured and ringed during egg incubation, during the feeding phase (e.g. day 14) or both. Adults and chicks are fit with a ring with a unique number issued by the British Trust of Ornithology (BTO). The BTO data base has also a copy of data of all birds measured, recaptured and ringed for this project. At least from 2021 this data contains nest box location.

Some years up to 2015 birds were marked with colour rings beside the metal numbered ring. Females were fit with one red ring in each leg, males with a black ring in each leg. An additional ‘year’ colour ring was added in left leg. Chicks were fit with the ‘year’ colour ring. Rings colours are read from left then right leg, from top to bottom ring.

Table: COLOURING
<table><tr><td>Code</td><td>Colour</td></tr><tr><td>N</td><td>Black</td></tr><tr><td>O</td><td>Orange</td></tr><tr><td>R</td><td>Red</td></tr><tr><td>X</td><td>Metal ring</td></tr></table>
Blood samples have been taken from adults and chicks using UK Home Office permits. Chick blood samples are taken on day 14 visit except for 2017 when day were taken day 7.

Swap samples from chick’s cloaca taken at day 7 and 14 from nest that breed at different times across the season (early, medium, late) in 2023. Samples: sterile cotton touch cloaca several times while holding the chick with gloves. Chick marked by nail clipping to be recognize at subsequent date. Cotton put in 100% ethanol and refrigerated (fridge)

Nest Building: In early springs Blue Tit females start building nests inside nest boxes. Nest building can last several days to weeks and is common to find a great</td></tr>
</table>

variation in the timing and complexity of the end results. Females use several materials to build their nest, but they mostly consist of a base made of moss and dry weeds and a soft layer made up of feathers, hair, and/or wool where eggs and chicks can be kept warm. We have created a score system to monitor the process of nest building through time with four stages shown in these pictures:

Table: NEST_SCORE

Score	Description
0	Nest box empty
0.25	Nest building began: a thin layer of loose moss or dry weeds inside. Bottom of box still exposed
0.5	A large and well donut-shaped layer of moss or dry weeds is present. Bottom not exposed
1	The nest lined with softer materials like hair, feathers and/or wool

Nest building scores are recorded before and during the breeding season until eggs are laid or visits to boxes stop. NestBuilding.csv table contains scores of nest before the breeding season and until the first eggs is laid. Only dates with changes in score are recorded.

2. Data 2002 to 2013

Information from published literature suggest data collection from 2002 to 2013 was done in a way very similar to protocols adopted in 2015. However, only one data file remains from 2002 to 2013 with missing dates, species and measuring days. All data in this file has been assumed to be from Blue Tit broods.

From published data:

- From 2002-2007 adults were measured and ringed on nest with 14 to 17-day old chicks (Bell et al 2014, Hardfield et al 2006_PRS, Innes_MScThesis_2007).
- In 2008 adults measured and ringed during egg incubation (Greenough_MScThesis_2008)
- From 2002-2008 nest were part of cross-fostering experiments
- From 2002-2007 chicks were measured at day 15 (Hardfield et al 2006, 2006, Hinks_MScThesis_2006, Innes_MScThesis_2007).
- In 2011 chicks were measured at day 14 (Azam_UGThesis_2011)
- In 2003, 2006, 2011 chicks were ringed by day 7-9 (Hardfield et al 2006_JEB, Hinks_MScThesis_2006, Azam_UGThesis_2011).
- In 2003 130 nest had cross-fostered chicks. 74 nests with cross-fostered chicks were allocated for carotenoid-feeding experiments from day 3 to 11 (CM-carotenoid+mealworm, M-mealworm, NT-no treatments (Hardfield et al 2006_JEB)
- In 2002 102 nests were used for cross fostering experiment (Hardfield et al 2006_PRS.)
- In 2004 82 nests also subjected to immune challenge experiment. Chicks were injected with either phosphate buffered saline solution (PBS) or phytohaemagglutinin (PHA) (Jenkins_UGThesis_2004)
- In 2005 108 nests used for reciprocal cross- fostering experiment (HendersonUGThesis_2005)

- In 2007 some nest box used in cross nests hatching date manipulations and feeding experiments (Orros_MScThesis_2007)
- In 2008 there was a brood age and brood number manipulation experiment (Greenough_MScThesis_2008)

TABLE: MANIPULATION

Year	Name in database	#	ASSUMED meaning
2002	CHXF	108	Chicks cross fostering
2006	CF	92	Chicks cross fostering
2006	MNCF	1	No cross fostering
2006	NCF	28	No cross fostering
2007	Advance unfed	22	Received eggs incubated for 8 days, own 5 days
2007	Advance fed	23	Received eggs incubated for 8 days, own 5 days + mealworms
2007	Control fed	39	Mealworms
2007	Control unfed	37	No manipulations
2007	Delayed fed	23	Received eggs incubated for 5 days, own 8 days + mealworms
2007	Delayed unfed	23	Received eggs incubated for 5 days, own 8 days
2008	AE	8	Own 1-day brood switched for 4-day brood equal size
2008	AL	5	Own 1-day brood switched for larger 4-day brood
2008	AS	12	Own 1-day brood switched for smaller 4-day brood
2008	DE	6	Own 4-day brood switched for 1-day brood equal size
2008	DL	8	Own 4-day brood switched for larger 1-day brood equal size
2008	DS	11	Own 4-day brood switched for 1-smaller day brood equal size
2009	AE	10	Unknown
2009	AL	11	Unknown
2009	AS	12	Unknown
2009	C	48	Unknown
2009	DE	10	Unknown
2009	DL	12	Unknown
2009	DS	11	Unknown
2009	EE	8	Unknown
2009	EL	5	Unknown
2009	ES	5	Unknown

Quality control

Phenology observations have been done by different researchers over the years. A complete list can be found in file: observers.csv

Curation of data files and creation of metadata has been done by several people. Catalina Estrada since November 2022. Please read README_DataBaseBlueTits.txt to see specific issues and decisions taken.

Data table metadata	
Number of tables	10
	NestBoxes_breeding_2002_2013.csv
	NestBoxes_breeding_2015On.csv
	Parents_2002_2013.csv
	Parents_2015On.csv
	Chicks_2002_2013.csv
	Chicks_2015On.csv
	NestBuilding.csv
	NextBoxes_location.csv
	observers.csv
	SwapSamples.csv
Format	.csv, .txt

File name	**NestBoxes_breeding_2002_2013.csv**		
Description	**Contains the usage of nest boxes throughout the breeding season from 2002 to 2013**		
Size	150 KB		
Case sensitive	no		
Number or records	2744		
Number of attributes	12		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
NestBox_Record	Unique number for a nest box usage throughout the study.	Integer	Count Min: 1, Max: 2744
Brood_ID	Unique name for brood history, parents and surviving chicks in a given nest box and in a given year. Link to tables: **Parents_2002_2013.csv, Chicks_2002_2013.csv**	String	Name: combine year and nest box ID YYYY_[NestBoxID]
Year	Year the observations were made	Date	YYYY Min: 2002, Max: 2013
NestBoxID	Name of Nest Box. **Link to table: NextBoxes_location.csv**	String	Alphanumeric Nest boxes are marked with a letter and a number. In general, boxes within each woodland have the same letter
NestBox_Fate	Whether the nest box showed any signs of been used during the season.	String	Text used: if any data was associated to the nest box that year unused: a nest box was assumed

			to be unused when raw data table had no data reported for it
Species	Common name of species that breed on nest box	String	Text All assumed to be Blue Tit NA: nest not used
LayingDate	Day when the first egg of the clutch was estimated to have been laid	Integer	Dates in April days starting 1st April. Example: Day -2: 29 March Day 1: 1st April Day 31: 1st May Day 62: 1st June It is assumed that a Blue Tits female will lay and egg every day. If when visiting a nest box a single egg is found, the laying date is the date the egg was found. If two (or more) eggs are found, the laying date is the previous day (or one day per egg)
ClutchSize	Number of eggs found in nest at the clutch size check date which is about 15 days after first egg laid	Integer	Count NA: no eggs laid, no recorded
HatchingDate	Day when at least one egg was estimated to have hatched in the clutch	Integer	Dates in April days starting 1st April. NA: no eggs laid, no recorded
ChickNumber	Number of **live** chicks found in nest at the time of measuring/ringing them	Integer	Count NA: no eggs laid, eggs did not hatch, all chicks found dead previously, no recorded
Notes	Further information associated with nest record. Field notes	String	Text See TABLE: MANIPULATION NA: no recorded

File name	**NestBoxes_breeding_2015On.csv**		
Description	**Contains the usage of nest boxes throughout the breeding season starting 2015**		
Size	227 KB		
Case sensitive	no		
Number or records	1951		
Number of attributes	26		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description

NestBox_Record	Unique number for a nest box usage throughout the study.	Integer	Count Min: 2745
Brood_ID	Unique name for brood history, parents and surviving chicks in a given nest box and in a given year. Link to tables: **Parents_2015On.csv, Chicks_2015On.csv, NestBuilding.csv**	String	Name: combine year and nest box ID YYYY_[NestBoxID]
Year	Year the observations were made	Date	YYYY Min: 2015
NestBoxID	Name of Nest Box. **Link to table: NextBoxes_location.csv**	String	Alphanumeric Nest boxes are marked with a letter and a number. In general, boxes within each woodland have the same letter.
NestBox_Fate	Whether the nest box showed any signs of been used during the season.	String	Text used: if a birds build a nest AND lay eggs unused: if the nest box was empty or have a nest but not eggs were laid
Species	Common name of species that breed on nest box	String	Text Blue Tit, Great Tit, Coal tit, Nuthatch NA: none, not known or not recorded
LayingDate	Day when the first egg of the clutch was estimated to have been laid	Integer	Dates in April days starting 1st April. Example: Day -2: 29 March Day 1: 1st April Day 31: 1st May Day 62: 1st June It is assumed that a Blue Tits female will lay and egg every day. If when visiting a nestbox a single egg is found, the laying date is the date the egg was found. If two (or more) eggs are found, the laying date is the previous day (or one day per egg)
LayingDate_Estimated	Day when the laying date was observed	Integer	Dates in April days starting 1st April. This is the day when the egg laying date is recorded

			NA: when laying date is the same as observed date: there is one egg in the nest. NA: when the date of the observation was no reported, or nest was no used
ClutchSize_CheckDate	Day in the season when it is expected the female has finished laying eggs and nest can be check for Clutch size. It is estimated as **LayingDate + 15**	Integer	Dates in April days starting 1st April. NA: no eggs laid, no recorded
ClutchSize	Number of eggs found in nest at the ClutchSize_CheckDate. It includes eggs found broken or accidentally damaged by researcher	Integer	Count NA: no eggs laid, no recorded
Hatching_CheckDate	Day in the season when is expected the eggs will hatch. It is calculated as **LayingDate + ClutchSize + 11**	Integer	Dates in April days starting 1st April. NA: no eggs laid, no recorded
HatchingDate	Day when at least one egg was estimated to have hatched in the clutch	Integer	Dates in April days starting 1st April. NA: no eggs laid, no recorded
HatchingDate_Estimated	Day when the HatchingDate was observed	Integer	Dates in April days starting 1st April. This is the day when the Hatching date is recorded NA: when hatching date is the same as observed date: the chick seems to have hatched the same day the observation is made NA: no eggs laid, no recorded
Day7_CheckDate	Date when chicks are expected to be 7 days old and first set of measures can be done. Estimated as **HatchingDate + 7**	Integer	Dates in April days starting 1st April. NA: no eggs laid, no recorded
Day7_Date	Actual date when chicks about 7 days old have been counted and measured	Integer	Dates in April days starting 1st April. NA: no eggs laid, no recorded
Day7_ChickNumber	Number of **live** chicks	Integer	Count

	found in nest at the Day7_Date		NA: no eggs laid, eggs did not hatch, no recorded
Day14_CheckDate	Date when chicks are expected to be 14 days old and can be ringed and measures. Estimated as **HatchingDate + 14**	Integer	Dates in April days starting 1st April. NA: no eggs laid, eggs did not hatch, no live chicks found, no recorded
Day14_Day	Actual date when chicks about 14 day old have been counted and measured	Integer	Dates in April days starting 1st April. NA: no eggs laid, eggs did not hatch, all chicks found dead previously, no recorded
Day14_ ChickNumber	Number of **live** chicks found in nest at the Day14_Date	Integer	Count NA: no eggs laid, eggs did not hatch, all chicks found dead previously, no recorded
EggsUnhatched	Number of unhatched eggs found in nest. This is typically measured in Day 7 checks. In some years this might have been corrected from Number of eggs – Numbers of chicks (dead & alive)	Integer	Count NA: no eggs laid, no recorded
Fledge_CheckDay	Date when nest can be checked for fledging. Estimated as **HatchingDate + 19**	Integer	Dates in April days starting 1st April. NA: no eggs laid, eggs did not hatch, all chicks found dead previously, no recorded
Fledge_Date	Actual date when nest was checked, and it was empty	Integer	Dates in April days starting 1st April. NA: no eggs laid, eggs did not hatch, all chicks found dead previously, no recorded
Fledge_ChickNumber	Number of chicks expected to have fledged. This is estimated as the number of chicks counted in day 14 minus any dead chicks found in FledgeDate. In cases where this number was estimated in any other way, this is specified in	Integer	Dates in April days starting 1st April. NA: no eggs laid, eggs did not hatch, all chicks found dead previously, no recorded

	Notes		
FullNest_DeadDate	Date after hatching when all chicks where found dead	Date	Dates in April days starting 1st April. NA: no eggs laid, eggs did not hatch, chicks fledged, no recorded
ObserverID	Unique code for lead researcher during the year of data collection**. Link to table: observers.csv**	String	Code: inicial first name.second names. n.nXX for data related to initials XX initials in raw data of unknown researcher.
Notes	Further information associated with nest record. Field notes	String	Text NA: no recorded

File name	**Parents_2002_2013.csv**		
Description	**Contains information of male and females breeding in nest boxes between 2002 and 2013**		
Size	135KB		
Case sensitive	no		
Number or records	2632		
Number of attributes	11		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
Parents_Record	Unique number for the capture of an adult bird in this study	Integer	Count Min: 1, Max: 2632
Brood_ID	Unique name for brood history, parents and surviving chicks in a given nest box and in a given year. Link to tables: **Parents_2002_2013.csv, NestBoxes_breeding_2002_2013.csv**	String	Name: combine year and nest box ID YYYY_[NestBoxID]
Year	Year the observations were made	Date	YYYY Min: 2002, Max: 2013
NestBoxID	Name of Nest Box. **Link to table: NextBoxes_location.csv**	String	Alphanumeric Nest boxes are marked with a letter and a number. In general, boxes within each woodland have the same letter.
RingNumber	BTO ring number that identify bird caught in nest box.	String	Alphanumeric
CaptureTime	Time in the day bird was captured	Time	HH:MM British Summer Time (BST)

Species	Species code (British Trust of Ornithology)	String	Nominal Table: NAMESP **Assumed all Blue Tits**
Sex	Sex of bird captured. BTO used criteria	String	Nominal F: female M: male
Age	Estimated age of bird captured	Integer	EURING age codes 5: 'Hatched during previous calendar year' 6: Hatched before last calendar year' NA: no recorded
Tarsus	Tarsus length of bird	Floating point	Units: millimetres to 0.01 precision. Uncertain if refer to minimum or maximum Tarsus (BTO: Ringer's Manual) NA: no recorded
Wing	Wing length defined as distance on the closed wing from the foremost extremity to the longest primary feather (BTO)	Integer	Units: millimetre to the closest millimetre NA: no recorded
Weight	Total weight of bird	Floating point	Units: grams to 0.01 precision. NA: no recorded
Notes	Further information associated with bird record. Field notes	String	Text NA: no recorded

File name	**Parents_2015On.csv**		
Description	**Contains information of male and females breeding in nest boxes from 2015**		
Size	159KB		
Case sensitive	no		
Number or records	1582		
Number of attributes	21		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
Parents_Record	Unique number for the capture of an adult bird in this study	Integer	Count Min: 2633
Brood_ID	Unique name for brood history, parents and surviving chicks in a given nest box and in a given year.	String	Name: combine year and nest box ID YYYY_[NestBoxID]

	Link to tables: **Parents_2015On.csv, NestBoxes_breeding_2015On.csv, NestBuilding.csv**		
Year	Year the observations were made	Date	YYYY Min: 2015
NestBoxID	Name of Nest Box. **Link to table: NextBoxes_location.csv**	String	Alphanumeric Nest boxes are marked with a letter and a number. In general, boxes within each woodland have the same letter.
RingNumber	BTO ring number that identify bird caught in nest box.	String	Alphanumeric
CaptureDate	Date when bird was captured	Date	Dates in April days starting 1st April. NA: no recorded
CaptureTime	Time in the day bird was captured	Time	HH:MM British Summer Time (BST)
Species	Species code (British Trust of Ornithology)	String	Nominal Table: NAMESP
Sex	Sex of bird captured. BTO used criteria	String	Nominal F: female M: male
Age	Estimated age of bird captured	Integer	EURING age codes 5: 'Hatched during previous calendar year' 6: Hatched before last calendar year' NA: no recorded
RecordType	Whether the capture bird is a new record or recaptured bird	String	Nominal R: Recapture o a previously ringed bird N: New bird ring record
ColourRing	Code of colour rings in legs of capture bird	String	Code for colours and position See table COLOURING NA: no colour rings present, no recorded
BloodSample	Name of vial containing blood sample for bird	String	Consecutive numbers unique within a breeding season NA: no sample available
Wing	Wing length defined as distance on the closed wing from the foremost extremity to the longest primary feather (BTO)	Integer	Units: millimetre to the closest millimetre NA: no recorded

Tarsus	Tarsus length of bird	Floating point	Units: millimetres to 0.01 precision. Uncertain if refer to minimum or maximum Tarsus (BTO: Ringer's Manual) NA: no recorded
Head	Total head length measured from base of skull to tip of bill	Floating point	Units: millimetres to 0.01 precision. (BTO: Ringer's Manual) NA: no recorded
Beak	Bill length of bird measured from base to tip of bill or beak	Floating point	Units: millimetres to 0.01 precision. (BTO: Ringer's Manual) NA: no recorded
Weight	Total weight of bird	Floating point	Units: grams to 0.01 precision. NA: no recorded
Mites	Presence of mites on one extended wing of bird	String	Count or categories 0: no mites observed > < 10 > < 20 > 40 > 50 NA: no recorded
ObserverID	Unique code for ringer associated with record. **Link to table: obervers.csv**	String	Code: initial first name.second names. n.nXX for data related to initials XX initials in raw data of unknown researcher
Notes	Further information associated with bird record. Field notes	String	Text NA: no recorded

File name	**Chicks_2002-2013.csv**		
Description	**Contains information of chicks breeding in nest boxes between 2002 and 2013**		
Size	605 KB		
Case sensitive	no		
Number or records	9772		
Number of attributes	13		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
Chick_Record	Unique number for the capture of a nestling in this study	Integer	Count Min: 1, Max: 9772

Brood_ID	Unique name for brood history, parents and surviving chicks in a given nest box and in a given year. Link to tables: **Parents_2002_2013.csv, NestBoxes_breeding_2002_2013.csv**	String	Name: combine year and nest box ID YYYY_[NestBoxID]
Year	Year the observations were made	Date	YYYY Min: 2002 Max: 2013
NestBoxID	Name of Nest Box. **Link to table: NextBoxes_location.csv**	String	Alphanumeric Nest boxes are marked with a letter and a number. In general, boxes within each woodland have the same letter.
Species	Species code (British Trust of Ornithology)	String	Nominal Table: NAMESP **Assumed all Blue Tits**
RingNumber	BTO ring number that identify bird caught in nest box	String	Alphanumeric NA: bird no ringed
Age	Estimated age of bird captured	Integer	EURING age codes 1: Pullus (nestling)
Tarsus	Tarsus length of bird measured (age of measuring in days after hatching predicted day 14-15)	Floating point	Units: millimetres to 0.01 precision. Uncertain if refer to minimum or maximum Tarsus (BTO: Ringer's Manual) NA: no recorded
Wing	Wing length defined as distance on the closed wing from the foremost extremity to the longest primary feather (BTO) (age of measuring in days after hatching predicted day 14-15)	Floating point	Units: millimetres to 0.01 precision. NA: no recorded
Weight	Total weight of bird (age of measuring in days after hatching predicted day 14-15)	Floating point	Units: grams to 0.01 precision. NA: no recorded
Fate	Fate of ringed bird	String	Nominal. The meaning of some categories are unknown or can be guessed as there is not metadata or contact with data collectors. FL: assumed it is 'Fledged' DAM: assumed 'Dead after

			measured” DBM: assumed ‘dead before measured’ DEAD 0: unknown 1: unknown N: unknown Y: unknown NA: no recorded
Manipulation	Experimental treatment given to chick (J.D Hadfield PhD thesis 2015)	String	Nominal. The meaning of the treatment name is unknown. CF: assumed cross-fostered (but Carotenoid Feeding was part of experiment) NA: no recorded
Notes	Further information associated with bird record. Field notes	String	Text: e.g. code name of chick before ring number containing NestBoxID NA: no recorded

File name	**Chicks_2015On.csv**		
Description	**Contains information of chicks breeding in nest boxes**		
Size	829 KB		
Case sensitive	no		
Number or records	6254		
Number of attributes	23		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
Chick_Record	Unique number for the capture of a nestling in this study	Integer	Count Min: 9773
Brood_ID	Unique name for brood history, parents and surviving chicks in a given nest box and in a given year. Link to tables: **Parents_2015On.csv, NestBoxes_breeding_2015On.csv, NestBuilding.csv**	String	Name: combine year and nest box ID YYYY_[NestBoxID]
Year	Year the observations were made	Date	YYYY

			Min: 2015
NestBoxID	Name of Nest Box. **Link to table: NextBoxes_location.csv**	String	Alphanumeric Nestboxes are marked with a letter and a number. In general, boxes within each woodland have the same letter.
ChickID	Identification of a chick within nest. Used when chicks were measured at day 7 and day 14	String	Mix Most years reported as consecutive numbers. Some years reported as nail cutting identification code: L: left leg R: right leg Nails 1 to 4
Species	Species code (British Trust of Ornithology)	String	Nominal Table: NAMESP
RingNumber	BTO ring number that identify bird caught in nest box	String	Alphanumeric NA: bird no ringed
Day7_CaptureDate	Date when bird was captured, 7 days after estimated hatching.	Date	Dates in April days starting 1st April. NA: no capture at day 7
Day7_CaptureTime	Time in the day bird was captured, 7 days after estimated hatching.	Time	HH:MM British Summer Time (BST) NA: no captured at day 7
Day7_Weight	Total weight of bird	Floating point	Units: grams to 0.01 precision. NA: no recorded
Day14_CaptureDate	Date when bird was captured, 14 days after estimated hatching.	Date	Dates in April days starting 1st April. NA: no captured or dead at day 14 visit
Day14_CaptureTime	Time in the day bird was captured, 14 days after estimated hatching.	Time	HH:MM British Summer Time (BST) NA: no captured or dead at day 7, no recorded
Day14_Wing	Wing length defined as distance on the closed wing from the foremost extremity to the longest primary feather (BTO) measured 14 days after estimated hatching	Integer	Units: millimetre to the closest millimetre NA: no recorded
Day14_Tarsus	Tarsus length of bird measured 14 days after	Floating point	Units: millimetres to 0.01 precision. Uncertain if refer to

	estimated hatching		minimum or maximum Tarsus (BTO: Ringer's Manual) NA: no recorded
Day14_Head	Total head length measured from base of skull to tip of bill measured 14 days after estimated hatching	Floating point	Units: millimetres to 0.01 precision. (BTO: Ringer's Manual) NA: no recorded
Day14_Beak	Bill length of bird measured from base to tip of bill or beak measured 14 days after estimated hatching	Floating point	Units: millimetres to 0.01 precision. (BTO: Ringer's Manual) NA: no recorded
Day14_Weight	Total weight of bird measured 14 days after estimated hatching	Floating point	Units: grams to 0.01 precision. NA: no recorded
Day14_Mites	Presence of mites on one extended wing of bird estimated 14 days after estimated hatching	String	Count or categories 0: no mites observed < 5 > < 10 > < 20 NA: no recorded
BloodSample	Name of vial containing blood sample for bird	String	Consecutive numbers unique within a breeding season NA: no sample available
Fledge_Date	Date when nest was checked, and it was empty. Bird expected to have fledge if dead body is not found on nest	Integer	Dates in April days starting 1st April. NA: Bird dead, no recorded
Dead_Date	Date when nest was checked bird was found dead	Integer	Dates in April days starting 1st April. NA: Bird fledged, no recorded
ObserverID	Unique code for ringer associated with record. **Link to table: observers.csv**	String	Code: initial first name.second names. n.nXX for data related to initials XX initials in raw data of unknown researcher
Notes	Further information associated with bird record. Field notes	String	Text NA: no recorded

File name	**NestBuilding.csv**
Description	**Gives information of the stage of nest development before and during of the breeding season**
Size	107KB

Case sensitive	no		
Number or records	1487		
Number of attributes	8		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
Nest_Record	Unique number for the nest building observations	Integer	Count Min: 1
Brood_ID	Unique name for brood history, parents and surviving chicks in a given nest box and in a given year. Link to tables: **Parents_2015On.csv, NestBoxes_breeding_2015On.csv, Chicks_2015On.csv**	String	Name: combine year and nest box ID YYYY_[NestBoxID]
Year	Year the observations were made	Date	YYYY Min: 2022
NestBoxID	Name of Nest Box. **Link to tables: NextBoxes_location.csv**	String	Alphanumeric Nestboxes are marked with a letter and a number. In general, boxes within each woodland have the same letter.
Date	Date when observation was made	Date	Dates in April days starting 1st April. March 31st = 0 March 30th = -1 March 1st = -30
Nest_score	Number representing the stage of development of nest the day of visit	String	Category See Table: NEST_SCORE
ObserverID	Unique code for ringer associated with record. **Link to table: observers.csv**	String	Code: initial first name.second names. n.nXX for data related to initials XX initials in raw data of unknown researcher, XX.ug id data taken as part of an undergraduate course
Photo_link	Link to a photograph of the nest	String	Links deposited in Epicollect5 projects NA: not link or photograph available

File name	**observers.csv**
Description	**Gives information of people involved in data collection**

Size	3 KB		
Case sensitive	no		
Number or records	30		
Number of attributes	6		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
ObserverID	Unique code. **Link to tables Nextboxes_breeding.csv Parents_2015On.csv Chicks_2015On.csv**	String	Code: initial first name.second names. n.nXX for data related to initials XX initials in raw data of unknown researcher
FirstName	Observer first name	String	Text
SecondName	Observer second name	String	Text
Email	Observer email address when participated in project	String	Text NULL: unknown
ObserverType	Observers position at Imperial College London or other institution during data collection	String	Codes proj.stu: Master or Undergraduate student proj.staff: Project leaders or technicians amat.vis: visitor NULL: unknown
Notes	Further information associated with researcher	String	Text

File name	**NextBoxes_location.csv**		
Description	**Give information about the location and type of Blue and Great Tit nest boxes**		
Size	25KB		
Case sensitive	No		
Number or records	340		
Number of attributes	12		
Orientation	Variables (attributes) included as columns		
Files used to fill data	Read README_DataBaseOaks.txt to find out how this table was built		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
NestBoxID	Name of Nest Box. **Link to tables NestBoxes_breeding_2015On.csv Parents_2015On.csv Chicks_2015On.csv**	String	Alphanumeric Nestboxes are marked with a letter and a number. In general, boxes within each woodland have the same letter.
Type	Type of nest box, determined by the size of entrance hole	Integer	Nominal 26: entrance hole is 26 mm

			diameter 32: entrance hole is 26 mm diameter
TreeID	Unique number given to each tree, **Link to table trees.cvs in Oaks DataBase**	Integer	NA: unknown
latitude	Latitude: north-south position WGS84	Floating point	Geographic coordinate in decimal degrees NA: unknown
longitude	Longitude: east-west position WGS84	Floating point	Geographic coordinate in decimal degrees NA: unknown
northing	Great Britain, National Grid, northing (Ordnance Survey)	Floating point	Geographic coordinate NA: unknown
easting	Great Britain, National Grid, easting (Ordnance Survey)	Floating point	Geographic coordinate NA: unknown
species	Scientific name of species of tree where nest box is located	String	NA: unknown
InOut	Whether the tree (TreeID) currently host a nest box	String	In: Nest box is currently on this tree Out: Nest box was moved to other tree or taken out of the study
action	Whether the nest box (NestBoxID) was introduced or removed from a tree (TreeID) in the given date/year	String	set: nest box hanged on tree out: nest box removed form tree
year	If action set: year of the first breeding season when tree (TreeID) hosted nest box (NestBoxID) If action out: year of the last breeding season when tree (TreeID) hosted nest box (NestBoxID)	Date	YYYY
date	Day when a NestBoxID was set up (set) or taken down from a tree (TreeID) (out)	Date	DD/MM/YYYY NA: not known

File name	**SwapSamples.csv**
Description	**Give information about swap samples used for microbiomas**
Size	4KB
Case sensitive	No
Number or records	80
Number of attributes	10
Orientation	Variables (attributes) included as columns
Files used to fill data	
Data table structure and attribute description	

Attribute name	Definition	Type	Attribute description
SampleID	Unique number given to a swap sample	Integer	Nominal
Year	Year the observations were made	Date	YYYY Min: 2023
NestBoxID	Name of Nest Box. **Link to tables NextBoxes_location.csv NestBoxes_breeding_2015On.csv Parents_2015On.csv Chicks_2015On.csv**	String	Alphanumeric Nestboxes are marked with a letter and a number. In general, boxes within each woodland have the same letter. NA: for control samples
RingNumber	BTO ring number that identify bird caught in nest box. **Link to table Chicks_2015On.csv**	String	Alphanumeric NA: bird no ringed or control samples
ChickID	Identification of a chick within nest. Used when chicks were measured at day 7 and day 14 **Link to table Chicks_2015On.csv**	Integer	Nominal Reported as consecutive numbers. NA: for control samples
ChickAge	Estimated day after hatching when chick was sampled	Integer	Nominal 7: Day 7 15: Day 14 NA: for control samples
CaptureDate	Date when bird was captured	Date	Dates in April days starting 1st April.
BreedingTime	Category describing timing of breeding within season	String	Nominal early: First nests with hatching chicks middle: Nest with hatching chicks in season peak late: Last nest to have hatching chicks NA: for control samples
ObserverID	Unique code for ringer associated with record. **Link to table: observers.csv**	String	Code: initial first name.second names. n.nXX for data related to initials XX initials in raw data of unknown researcher, XX.ug id data taken as part of an undergraduate course
Notes	Further information associated with sample	String	Text

Data anomalies	
	README_DataBaseOaks contains information of data curation for table NestBoxes_location.csv README_DataBaseBlueTits contains information of data curation for other tables described here. Location of nest boxes in territory K (NestBoxID: K01 to K12), E09, E14, E19, J11 were estimated from a printed map. Date of set up, removal or changes of nest boxes location was not recorded before 2019. The year of nest boxes set up or removal before 2019 have been derived from the breeding records. All data from 2002 to 2013 is assumed to be from Blue Tit broods (which is has a high probability to be correct). Older data file has not metadata attached so during curation we have made assumptions which are highlighted in file README_DataBaseBlueTits.txt and the table descriptions above

Supplemental descriptors	
Publications	7
	Hadfield JD, Burgess MD, Lord A, Phillimore AB, Clegg SM, Owens IP (2006) Direct versus indirect sexual selection: genetic basis of colour, size and recruitment in a wild bird. *Proceedings of the Royal Society B: Biological Sciences* 273: 1347–1353 https://doi.org/10.1098/rspb.2005.3459
	Hadfield JD, Owens IPF. 2006. Strong environmental determination of a carotenoid-based plumage trait is not mediated by carotenoid availability. Journal of Evolutionary Biology 19: 1104–1114. https://doi.org/10.1111/j.1420-9101.2006.01095.x
	Hadfield JD, Nutall A, Osorio D, Owens IPF. 2007. Testing the phenotypic gambit: Phenotypic, genetic and environmental correlations of colour. Journal of Evolutionary Biology 20: 549–557. https://doi.org/10.1111/j.1420-9101.2006.01262.x
	Thorley JB, Lord AM (2015) Laying date is a plastic and repeatable trait in a population of blue tits Cyanistes caeruleus. Ardea 103 (1): 69-78. https://doi.org/10.5253/arde.v103i1.a7
	Villemereuil PD *et al.* (2020) Fluctuating optimum and temporally variable selection of breeding date in birds and mammals. PNAS: 117: 31969-31978. https://doi.org/10.1073/pnas.2009003117
	Culina A, *et al.* (2021) Connecting the data landscape of long-term ecological studies: The SPI-Birds data hub. Journal of Animal Ecology 90: 1997-2226. https://doi.org/10.1111/1365-2656.13388
	Chik HYJ, Estrada C, Wang Y, Tank P, Lord AM, Schroeder J (2022) Individual variation in reaction norms but no directional selection in reproductive plasticity of a wild passerine population. Ecology and Evolution 12: e8582. https://doi.org/10.1002/ece3.8582
Website	https://www.imperial.ac.uk/silwood-park/research/silwood-lte/blue-tits/

How to cite database	Contact c.estrada@imperial.ac.uk
How to acknowledge dataset	Contact c.estrada@imperial.ac.uk
Additional information	Sampling protocoles can be found in: Lopera Doblas (2017) Field Season Protocol, file: handbook.pdf Oak database Maps showing nest boxes and trees in google, GIS