Title	**Oak tree phenology**
General metadata	
Abstract	The leaf-out phenology of a proportion of tagged oak trees (*Quercus robur*) is annually monitored from March to June to register the date of six stages from bud burst to fully extended and hardened leaves.
Keywords	Leaf burst, oak, phenology
Is this part of a larger study?	Yes, This observations are pat of the blue tits breading season study
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Funding	Imperial College London, Department of Life Science
Data set status and accessibility	
Status	Ongoing
Latest update	February 2022
Latest archive date	February 2022
Metadata status	February 2022
Accessibility	
Storage location and medium	"Research group space: SilwoodLTE", Imperial College London, ICT department
Usage rights	Open access
Geographic metadata	
Geographic description	The study site is Silwood Park Campus from Imperial College London, Buckhurst Road, Ascot, Berkshire SL5 7PY, United Kingdom. Silwood Park campus, with 100

<table>
<tr><td></td><td>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 annual rainfall of 697mm with little seasonal pattern (1987-2019). Mean hourly temperature is 10ºC with July max of 23 ºC and February min of 1.2 ºC (1987-2019).</td></tr>
<tr><td>Bounding coordinates</td><td>General for Silwood Park. The specific location and detail information of trees can be found in file: tblTrees.csv.
In 2020 part of the campus boundaries changed and this resulted in the loss of about 116 trees.</td></tr>
<tr><td></td><td></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></td><td></td></tr>
<tr><td>Temporal metadata</td><td></td></tr>
<tr><td>Temporal description</td><td>Oak leaf bursting has been observed in a series of trees since 2007. Trees have been divided in those observed each year (Long term trees) or those observed every other year; in even (even trees) or odd years (odd trees). Trees enter the database to replace dead individuals in any category.
Missing data: 2020</td></tr>
<tr><td>Begin</td><td>2007</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:</td><td>Angiospermae</td></tr>
<tr><td>Taxonomic level: Species</td><td>Table: NAMESP
<table>
<tr><td>Species</td><td>Species code</td></tr>
<tr><td>Quercus robur</td><td>quercus.robur</td></tr>
<tr><td>Fagus sylvatica</td><td>fagus.sylvativa</td></tr>
<tr><td>Populus sp.</td><td>populus.sp</td></tr>
<tr><td>Unidentified conifer</td><td>conifer</td></tr>
<tr><td>Castanea sativa</td><td>castanea.sativa</td></tr>
<tr><td>Carpinus betulus</td><td>carpinus.betulus</td></tr>
<tr><td>Betula pendula</td><td>betula.pendula</td></tr>
<tr><td>Alnus sp.</td><td>alnus.sp</td></tr>
<tr><td>Aesculus hippocastanum</td><td>aesculus.hippocastanum</td></tr>
<tr><td>Acer pseudoplatanus</td><td>acer.pseudoplatanus</td></tr>
<tr><td>Juglans regia</td><td>juglans.regia</td></tr>
</table></td></tr>
<tr><td>Methods</td><td></td></tr>
</table>

metadata	
General experimental design	Extracted from: Lopera Doblas (2017) Field Season Protocol -handbook.pdf There are approximately 3700 individually marked oak trees in Silwood, divided into three categories: long term oaks which are monitored every year, odd year oaks and even year oaks which are monitored in odd and even years respectively. Trees should be marked at the beginning of the season with tape in order to identify from the distance. Trees are associated by distance to a named bird box. There is a network of woodcrete nest boxes across the campus' woodlands used to study the breeding phenology of blue tits. From 286 nest boxes in 2019, 32 were excluded from experiment due to the sale of campus land. 1 was removed by damage of tree. In 2022 there are 220 active nest boxes, 173 boxes have a small entrance (26 mm) that exclude great tits and 47 have a larger entrance (32mm).
Data collection	Monitoring involves visiting every individual oak every other day from March 20th onwards to look for signs of leaf development, and scoring them according to the scale below, until they reach stage 6  Figure: different stages of the leaves. 0 = no sign of green 1 = green just showing 2 = budburst i.e., when the bud is elongated 3 = shaving brush leaves emerged 4 = leaves fully extended 5 = trees anthers shedding pollen 6 = leaves turned dark green and waxy (tanninised) If a tree has some leaves (not just 2, something easy to find by another observer) in stage 3, the whole tree will be in stage 3. It is important to decide when a tree is in a certain stage and always do it on the same way in order to avoid differences between observations. Once a tree reaches stage six it is also given a defoliation score (how much has been eaten by caterpillars!). Defoliation scores: 6 = 100 % leaf area loss 5 = 50-99% 4 = 25-49% 3 = 12-24% 2 = 6-11% 1= 1-5% 0 = intact leaf At this stage, the person recording the stage of the tree should stand under the tree to get the defoliation score. For this, divide the tree in areas and establish a general

	score for the whole tree. It could happen that the upper part of the tree is been eaten and the bottom has not. **Girth:** There is information of the circumference of some trees. File "oaks_GIS data" contains circumference information for some trees but has not a date associated. In the database (tblGirth.csv) these measures have been identified as 2007-2015 girths. Some measures have been done since from a period of three years, also without a date, this are identified as 2016-2019. None have an associated VisitID. Read README_DataBaseOaks.txt to find more.
Quality control	Phenology observations have been done by different researchers over the years. A complete list can be found in file: tblObservers.csv Curation of data files and creation of metadata has been done by Catalina Estrada since January 2018. Please read README_DataBaseOaks.txt to see specific issues and decisions.
Data table metadata	
Number of tables	7

File name	**SilwoodCollectors.csv, SilwoodCollectors.txt**		
Description	**Gives information of people involved in data collection for this and other projects at Silwood Park**		
Size	5KB		
Case sensitive	no		
Number or records	37		
Number of attributes	8		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
ObserverID	Unique code, Primary key	String	Code: inicial 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 NA: unknown
Position	Observers position at Imperial College London or other institution during data collection	String	Text MSc: Master students MSc and MRes
Source	Source of data used for this observer or researcher	String	Text Thesis (UG and MSc), Long term experiments (LTE), Sightings, Surveys, Monitoring. One one observer has several types of

			source only one added.
Code	Code name used to relate to other information in data base for this researcher. Primary key in file FieldProjects_list	String	Text: This help locate data and application forms for researchers.
Notes	Further information associated with researcher	String	Text

File name	**tblTreeMarks.csv, tblTreeMarks.txt**		
Description	**Give information of the kind of marks trees might receive**		
Size	428 bytes		
Case sensitive	no		
Number or records	4		
Number of attributes	3		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
MarkID	Unique text to recognize the type of mark given to a tree. Primary key	String	Text: Tag, Blue, Round, Spec
Description	Brief description of marks applied and uses	String	Text
Picture	Name of picture that show an example of mark. All pictures are included in folder TreeMarks	String	Text

File name	**tblVisits.csv, tblVisits.txt**		
Description	**Give information of when and who visited trees to do something to them (e.g. phenology scoring, tagging, measure)**		
Size	2.5 MB		
Case sensitive	No		
Number or records	1003098		
Number of attributes	4		
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
VisitID	Unique number for each visit to a tree, Primary key	Integer	Count Min: 1, Max: 100231
TreeID	Unique number given to each tree, Foreign key from: TblTrees.csv	Integer	Count Min: 1, Max: 3997
Date	Date visit happen	date	DD/MM/YYYY
ObserverID	Unique code, Foreign key from:	String	Code: inicial first name.second names. n.nXX for data related to

	SilwoodCollectors.csv		initials XX initials in raw data of unknown researcher NA: no available

File name	**tblMarkings.csv, tblMarkings.txt**		
Description	**Give information of markings (tags) given and changed**		
Size	75KB		
Case sensitive	No		
Number or records	4097		
Number of attributes	4		
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
VisitID	Unique number of visit when a mark was put in a tree. Primary key, also in TblVisits.csv	Integer	Count Min: 1, Max: 100102
TreeID	Unique number given to each tree, Foreign key from: TblTrees.csv	Integer	Count Min: 1, Max: 3985
MarkID	Unique text to recognize the type of mark given to a tree. Foreign key from tblTreeMarks.cvs	String	Text: Tag, Blue, Round, Spec
MarkNumber	Unique number in mark given	Integer	Count Min: 1, Max: 23665 NA: no available

File name	**tblTrees.csv, tblTrees.txt**		
Description	**Give information about trees including location, territory, and status**		
Size	324KB		
Case sensitive	No		
Number or records	3997		
Number of attributes	11		
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
TreeID	Unique number given to each tree involved in this or other experiment in Silwood Park campus. Primary key	Integer	Count Min: 1, Max: 3997
species	Species of oaks as Table: NAMESP	String	Text Note: When Quercus assumed to be quercus.robur .ID needs to be confirmed for some trees,

			particularly those note by ?
Northing	Great Britain, National Grid, northing (Ordnance Survey)	Floating point	Geographic coordinate NA: no available
Easting	Great Britain, National Grid, easting (Ordnance Survey)	Floating point	Geographic coordinate NA: no available
Latitude	Latitude: north-south position WGS84	Floating point	Geographic coordinate NA: no available
Longitude	Longitude: east-west position WGS84	Floating point	Geographic coordinate NA: no available
SPlocation	Silwood Park named woodland or field where tree is located	String	Text following Silwood Park Site Plan 6/12/08- As field boundaries are not quite clear this location might not be always accurate
NestBoxHost	Name of Nest Box set in the tree Foreign key from tblNestBoxes.cvs	String	Alphanumeric Blue tit or great tit's Nestboxes are marked with a letter and a number. In general, boxes within each woodland have the same letter. NA: tree without a nest box
NestBoxID	Name of Nest Box associated to this tree, territory. Foreign key from tblNestBoxes.cvs	String	Alphanumeric Territories are associated with one blue tit or great tit's nest box. Nestboxes are marked with a letter and a number. Some trees have been related to more than one territory in data sets.
state	Whether tree is dead, alive or has been removed from study	String	Text alive: if standing with any signal of being alive (leaves). dead: standing or fallen without leaves. dead?: to be confirmed dead. not found: tag has not yet found on a tree dead or alive out: Tree taken out of the study even if alive (e.g. 2020 sale of campus land) NA: no information available
VisitID	Unique number of visit when tree was reported dead or taken out of study	Integer	Count Min: 3381, Max: 100231
remarks	Any other relevant information about the tree	String	Text oak1 to oak30 is a Foreign key related to table oak_acorn_oaks.csv table from different long term experiment

File name	**tblPhenology.csv, tblPhenology.txt**
Description	**Give information about the phenology codes for leave flushing through spring.**
Size	1.7MB
Case sensitive	No
Number or records	98447
Number of attributes	5
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
VisitID	Unique number given to a visit to assess phenology, Primary key, also in TblVisits.csv	Integer	Count Min: 2826, Max: 100078
TreeID	Unique number given to each tree. Foreign key from TblTrees.csv	Integer	Count Min: 1, Max: 3837
Score	Number representation for the stage of leaf flushing of the tree in a given visit/day.	String	Alphanumeric Numbers 0 to 6, sometimes along with signals < and > 0 = no sign of green 1 = green just showing 2 = budburst i.e., when the bud is elongated 3 = shaving brush leaves emerged 4 = leaves fully extended 5 = trees anthers shedding pollen 6 = leaves turned dark green and waxy (tanninised) NA: not available
Anthers	Whether or not anters were present on the tree. Usually measured when leaf flushing is scored as 4 but see 'Data anomalies' below	String	Text N: anthers absent Y: anthers present NA: no available
Defoliation	Number representation for the degree of defoliation of the tree. Usually measured when leaf flushing is scored as 6 but see 'Data anomalies' below.	Integer	Numbers Min: 1, Max: 6 6 = 100 % leaf area loss 5 = 50-99% 4 = 25-49% 3 = 12-24% 2 = 6-11% 1= 1-5% 0 = intact leaf NA: no available

File name	**tblRotation.csv, tblRotation.txt**
Description	**Give information about the tree sampling schedule**
Size	42KB
Case sensitive	No
Number or records	1143

Number of attributes	4		
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
TreeID	Unique number given to each tree. Primary key also from TblTrees.csv	Integer	Count Min: 2826, Max: 3950
Rotation	Latest sampling schedule for a given tree	String	Text LTO: long term trees are sampled every year Even: trees sampled on even years only Odd: trees sampled on odd years only
YearIn	The year a tree enters the sampling schedule or changed rotation	Date	YYYY
Note	Text explain discrepancies on rotation data from raw data	String	Text

File name	**tblNestBoxes.csv, tblNestBoxes.txt**		
Description	**Give information about the location of blue and great tit nest boxes**		
Size	6KB		
Case sensitive	No		
Number or records	304		
Number of attributes	5		
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. Primary key	String	Alphanumeric Nestboxes are marked with a letter and a number. In general, boxes within each woodland have the same letter.
TreeID	Unique number given to each tree, Foreign key from tblTrees.cvs	Integer	Count Min: 1, Max: 3997
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
VisitID	Unique number for a visit when the nest box was set on tree, or moved to another tree or removed from study. Foreign key from TblVisits.csv	Integer	Count Min: 1, Max: 100146
state	Indicates when the nest box was set or removed to the particular tree	String	Nominal set: relate to the VisitID when nest

			box was set on tree out: relate to VisitID when the nest box was taken down the tree, either because the tree died or because the nest box was removed from study (change in land use/owner)

File name	**tblGirth.csv, tblGirth..txt**		
Description	**Give information about the location of blue and great tit nest boxes**		
Size	133KB		
Case sensitive	No		
Number or records	3504		
Number of attributes	8		
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
TreeID	Unique number given to each tree, Foreign key from tblTrees.cvs	Integer	Count Min: 1, Max: 3960
TreeForm	Basic architecture of tree	String	Text maiden: if tree stem is not divided at 1.3m height multistems: if tree stem is divided before 1.3 m height NA: information not available
Girth_cm	Circumference of the stem(s) at 1.3 m height	Integer	To the closest cm Min: 8, Max: 601
Stems	Number of stems measured and added in the girth value	Integer	Count Min: 1, Max: 4 NA: Information not available
HeightGirth_cm	The height where stem's circumference was measured	Integer	To the closest cm Min: 20, Max: 130 < 130: if measured was done before the standard but there is not information of specific height base: if measured was done at the base of three but is not information of specific height NA: information not available
Estimated	Whether or not the girth of stem could not be measured and was estimated	Integer	Nominal 0: no estimated, measured 1: estimated
VisitID	Unique number for a visit when girth was measured. Foreign key from TblVisits.csv	Integer	Count NA: information not available
Note	Text with field information	String	Text Please see above: Data collection/girth

Data anomalies	
	README_DataBaseOaks contains information of data curation for tables including the fate of potential mistakes from original data files. **Important note about Anthers and Defoliation columns in phenology table (tblPhenology) table**: Data table from 2007-2013 has not a date associated with the assessment of the presence of anthers and the assessment of defoliation. Therefore presence/absence of anthers (Y/N) and defoliation score are included in all dates a single tree was scored for leaf bursting in a given year. In the manual presence of Anthers are said to be reported when leaf bursting is at least level 4 and defoliation when leaf-bursting score is 6. For data starting 2015 scores for anthers and defoliation are associated with a particular date in the original data files. So, overall a presence (Y) or absence (N) of Anthers data should be read as the presence /absence of anthers in the tree in a given year of sampling regardless of the date it is associated with. Similar, defoliation score is interpreted as estimated defoliation of a tree in a given year of sampling.

Supplemental descriptors	
Publications	
Order	
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 A map linking tables by key columns: OakDataBase_map.pdf Map showing nest boxes: nest boxes.jpg