Title	Silwood Park English oak and Knopper gall wasp interaction
General metadata	
Abstract	Establishing temporal patterns of individual and population variations in species' ecological traits is important to understand the effects that changes in biotic or abiotic conditions cause to organisms. The annual production of acorns of *Quercus robur* and their predation by the alien cynipid gall-forming wasp species, *Andricus quercuscalicis*, has been monitored in the same 30 trees at Silwood Park since 1982. The abundance of Knopper gall wasps in England has been rapidly increasing since the species was first recorded in the 1960's, resulting in a substantial decline in *Q. robur* reproductive output and the alteration of the biology of the native community of cynipid wasps' natural enemies. A long time series data on each tree's growth, acorn production and rate of infection by Knopper galls is available.
Keywords	Quercus, oak, gall-forming wasp, Knopper gall, seed production, herbivory
Is this part of a larger study?	No
Individual: Primary contact	Mick Crawley
Position	Emeritus Professor of Plant Ecology
Organization	Department of Life Sciences, Imperial College London
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Email	m.crawley@imperial.ac.uk
Web address	http://www.imperial.ac.uk/people/m.crawley
Individual: Associated parties	Catalina Estrada
Position	Ecological Analyst and Facility Manager
Address	Silwood Park, Buckhurst Road, Ascot, Berkshire SL5 7PY. United Kingdom
Organization	Department of Life Sciences, Imperial College London
Phone	+44(0)2075942217
Email address	c.estrada@imperial.ac.uk
Funding	Mick Crawley: Department of Life Sciences, Imperial College
Data set status and accessibility	
Status	Stopped
Latest update	March 2020
Latest archive date	March 2020
Metadata status	February2021
Accessibility	
Storage location and medium	"Research group space: SilwoodLTE", Imperial College London, ICT department

<table>
<tr><td>Usage rights</td><td>Restricted</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 78 ha, contains grasslands, scrubland, ancient woodlands and few decades old oak-dominated woodlands. The 30 oak trees are located across the campus grounds, which are characterized with sandy, acidic soil of the Bagshot Series (National Vegetation Classification: acidic variant of MG5). 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 each tree can be found in file: oak_acorns.csv</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>Since 1982 the acorn crop and infection by Knopper gall wasps of 30 oak trees (Quercus robur) have been studied at Silwood Park. Tree #8 felled in the great storm of October 1986. Tree #10 was heavily pruned during a tree surgery work in September 2016. Tree #9 fell 16 March 2018. Trees #7, 14 and 15 are in a part of campus sold in March 2020.</td></tr>
<tr><td>Begin</td><td>1982</td></tr>
<tr><td>End</td><td>2015</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></table></td></tr>
<tr><td>Taxonomic level: Order</td><td>Insecta: Hymenoptera</td></tr>
<tr><td>Taxonomic level: Species</td><td>Table: NAMESP
<table><tr><td>Species</td><td>Species code</td></tr><tr><td>Andricus quercuscalicis</td><td>andricus.quercuscalicis</td></tr></table></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Methods metadata</td><td></td></tr>
<tr><td>General experimental design</td><td>In August 1982 30 oak trees (Quercus robur) that ranged in girth from 43 to 621 cm were chosen for long-term monitoring. About half of the trees were part of existing woodlands and the other half were stand-alone trees in grassland and arable fields. Information about each tree and their location</td></tr>
</table>

	can be found in the file **oak_acorns_oaks. csv** and available maps. Since 1982, annual data on growth, defoliation, acorn production, and infection by Knopper galls was collected in the fall for each tree. Tree number 8 died in the Great Storm of 1987 and tree 10 was heavily pruned losing its crown and limbs in 2016. Other trees have been struck by lightning losing limbs. Tree number 7, in particular, has been reduced to one branch since this happened in 1984. Tree 9 fell 16 March 2018. Trees 7, 14 and 15 are in a part of campus sold in March 2020.
Data collection	Peduncle (female inflorescence) production was counted in early spring in a number of shoots from branches accessible from the ground (ca 100) from some years Later in the year (fall), the number of acorn-cups or cupules (named objects) per shoot was counted as well as the fate of the objects; to either production of acorns or Knopper galls. The number of objects per shoot was counted in a variable number of shoots that range from 100 to about 2000. Changes in the order of magnitude in the number of shoots surveyed was done to reflect the fact that acorn production some years is very low in the whole tree and not just in shoots closer to the ground. Primary data of peduncle and acorn-cup production per shoot can be found since 2000 in file **oak_acorns_acorns.csv.** A single acorn-cup can produce as many as eight Knopper galls. Every year since 1982 the number of Knopper galls developing in an acorn-cup has been registered for a number of acorn-cups per tree. The number of Knopper gall was counted during the fall season in up to1000 acorn-cups per tree. Primary data on Knopper galls and acorn production can be found in the file **oak_acorns_galls.csv** since 2000. Table **oak_acorns_summary.csv** contains summarized information for the oak trees' growth and acorn/Knopper gall production through time. Data used for these calculations is available in tables **oak_acorns_galls.csv** and **oak_acorns_accorns.csv** since 2000 but for other years only an estimation of acorns and Knopper galls per shoot is available. The amount of acorns per shoot (**aps**) in each tree is estimated by multiplying the number of objects per shoot (ops) (e.g. data in file **oak_acorns_accorns.csv)** by the proportion of objects or acorn-cups not infected by Knopper galls (e.g. data in file **oak_acorns_galls.csv)**. The amount of galls per shoot (**gps**) in a tree is estimated by multiplying the number of objects per shoot (ops) (e.g. data in file **oak_acorns_accorns.csv)** by the average number of galls per object (e.g. data in file **oak_acorns_galls.csv)**. Tree growth is assessed by measuring girth at breast height and the lengths of a sample of primary shoots (shoots produced in first burst in May) and secondary shoots (lammas) when these are produced. The number of shoots measured varied from year to year, typically ranging between 30 and 50. Defoliation scores are also estimated for shoots using a 7-point logarithmic scale (score = % of leaf area lost): 0 = none; 1 = 1 - 3%; 2 = 4 - 10%; 3 = 11 - 24%; 4 = 25 - 49%; 5 = 50 - 99%; 6 = 100% Growth and defoliation primary data is available for a few number of years in the file **oak_acorns_growth.csv**, other years growth data is summarized in the file **oak_acorns_summary.csv**

<table>
<tr><td>Quality control</td><td>Professor Mick Crawley has managed this experiment since 1982. He has been directly involved in the collection of data.

Table NAMECOL
<table>
<tr><td>Code</td><td>Name</td><td>Email address</td></tr>
<tr><td>m.crawley</td><td>Mick Crawley</td><td>m.crawley@imperial.ac.uk</td></tr>
</table>

Curation of data files and creation of metadata has been done by Catalina Estrada since December 2016. Please read README_OakAcorn.txt to see details.</td></tr>
<tr><td>Data table metadata</td><td></td></tr>
<tr><td>Number of tables</td><td>4</td></tr>
<tr><td></td><td></td></tr>
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<table>
<tr><td>File name</td><td colspan="3">oak_acorns_oaks.csv and oak_acorns_oaks.txt</td></tr>
<tr><td>Description</td><td colspan="3">Information about the individual oaks included in study. Information shared with Oak Data base from Blur tit project</td></tr>
<tr><td>Size</td><td colspan="3">12KB</td></tr>
<tr><td>Case sensitive</td><td colspan="3">No</td></tr>
<tr><td>Number or records</td><td colspan="3">30</td></tr>
<tr><td>Number of attributes</td><td colspan="3">13</td></tr>
<tr><td>Orientation</td><td colspan="3">Variables (attributes) included as columns</td></tr>
<tr><td>Data table structure and attribute description</td><td colspan="3"></td></tr>
<tr><td>Attribute name</td><td>Definition</td><td>Type</td><td>Attribute description</td></tr>
<tr><td>tree</td><td>Name of one of the 30 oak trees monitored.
Primary key</td><td>String</td><td>Nominal
Code include the word Oak and a number from 1 to 30</td></tr>
<tr><td>TreeID</td><td>Unique number given to each tree in Silwood Park, Foreign key from: TblTrees.csv in oaks Data base</td><td>Integer</td><td>Up to 4 digits
Min: 499
Max: 4005</td></tr>
<tr><td>girth</td><td>Circumference of tree trunk at breast height in 2015</td><td>Floating point</td><td>Units: cm
Min: 83, Max: 583
NA: no data</td></tr>
<tr><td>location</td><td>Name or area inside Silwood Park campus where tree is located</td><td>String</td><td>Nominal
Names as in attached map</td></tr>
<tr><td>northing</td><td>Northward-measured distance in the UK geographic Cartesian coordinates system</td><td>Integer</td><td>UK National Grid</td></tr>
<tr><td>easting</td><td>Eastward-measured distance in the UK geographic Cartesian coordinates system</td><td>Integer</td><td>UK National Grid</td></tr>
<tr><td>latitude</td><td>Latitude for tree location</td><td>Floating point</td><td>Precision: 0.0000001 or 0° 00′</td></tr>
</table>

			0.00000″ (degrees, minutes, seconds)
longitude	Longitude for tree location	Floating point	Precision: 0.000001 or 0° 00′ 0.00000″ (degrees, minutes, seconds)
Tag	Number given in a aluminium circular tag	Integer	Four digits
Blue	Number given in a blue plastic rectangular tag	Integer	Four digits
State	Relevant information about latest state of the tree	String	Nominal alive dead: presumed dead out: excluded from experiment
VisitID	Number given to the visit of tree when state dead or out is recorded. Foreign key from: TblVisits.csv in oaks Data base	Integer	Up to 6 digits
note	Other relevant information	String	Text

File name	**oak_acorns_galls.csv and oak_acorns_galls.txt**		
Description	**Data of number of knnopper galls in eac acorn cups**		
Size	114KB		
Case sensitive	No		
Number or records	4591		
Number of attributes	5		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
year	Year data was collected	Integer	Date YYYY format Min: 1993, Max: 2015
tree	Name of one of the 30 oak trees monitored. **Foreign key from: oak_acorns_oaks.csv**	String	Nominal Code include the word Oak and a number from 1 to 30
gpo	Number of Knopper galls per acorn-cup or cupule (named object)	Integer	Count Min:0, Max: 8
frequency	Number of acorn-cups sampled in a tree with the given number of Knopper galls	Integer	Count Min: 0, Max: 1000 NA: missing data
collector	Name code of person responsible for collection and entry of data	String	Nominal Code included in table NAMECOL

File name	**oak_acorns_acorns.csv and oak_acorns_acorns.txt**		
Description	**Data on acorn production per shoot**		
Size	115KB		
Case sensitive	No		
Number or records	4591		
Number of attributes	5		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
year	Year data was collected	Integer	Date YYYY format Min: 1993, Max: 2015
tree	Name of one of the 30 oak trees monitored. **Foreign key from: oak_acorns_oaks.csv**	String	Nominal Code include the word Oak and a number from 1 to 30
ops	Number of acorn-cups (cupule) or peduncles in a tree shoot	Integer	Count Min:0, Max: 8
frequency	Number of shoots sampled in a tree with the given number of objects	Floating point	Count, but value 0.1 included Min:0, Max: 2000 NA for missing data
collector	Name code of person responsible for collection and entry of data	String	Nominal Code included in table NAMECOL

File name	**oak_acorns_growth.csv and oak_acorns_growth.txt**		
Description	**Data on seasonal growth in sample brances for study oaks**		
Size	115KB		
Case sensitive	No		
Number or records	3866		
Number of attributes	7		
Orientation	Variables (attributes) included as columns		
Data table structure and attribute description			
Attribute name	Definition	Type	Attribute description
year	Year data was collected	Integer	Date YYYY format Min: 1994, Max: 2004
tree	Name of one of the 30 oak trees monitored. **Foreign key from: oak_acorns_oaks.csv**	String	Nominal Code include the word Oak and a number from 1 to 30
shoot	Number of the shoot where data was taken	Integer	Numbers 1 to 55
primary	Primary shoot length	Floating point	Units: cm Precision: 0.0

			Type: real Min: 0, Max: 42
lammas	Lammas (secondary) shoot length	Floating point	Units: cm Precision: 0.0 Type: real Min: 0, Max: 82
damage	Defoliation score	Integer	7-point logarithmic scale (score = % leaf area lost) 0 = none 1 = 1 - 3% 2 = 4 - 10% 3 = 11 - 24% 4 = 25 - 49% 5 = 50 - 99% 6 = 100%
collector	Name code of person responsible for collection and entry of data	String	Nominal Code included in table NAMECOL

File name	**oak_acorns_summary.csv and oak_acorns_summary.txt**
Description	**Summary of acorn production, growth and Knooper gall infestation per year in each study tree.**
Size	83KB
Case sensitive	No
Number or records	1021
Number of attributes	16
Orientation	Variables (attributes) included as columns
Data table structure and attribute description	

Attribute name	Definition	Type	Attribute description
year	Year data was collected	Integer	Date YYYY format Min: 1982, Max: 2015
tree	Name of one of the 30 oak trees monitored. **Foreign key from: oak_acorns_oaks.csv**	String	Nominal Code include the word Oak and a number from 1 to 30
girth	Circumference of tree trunk at breast height	Floating point	Units: cm Min: 43, Max: 663 NA: no data
shoots1	Number of shoots examined to count the number of acorn-cups (cupule) or peduncles per shoot	Integer	Count Min:42, Max: 2001 NA: no data
ops	Average acorn-cups or peduncles (named objects) per shoot	Floating point	Precision 1 x 10^{-9} Min: 0, Max: 2.5 NA: no data
objects	Number of acorn-cups examined to count the number of galls per acorn-cup	Integer	Count Min:0, Max: 1000 NA: no data

galled	The proportion of examined acorn-cup (named objects) with at least one Knopper gall	Floating point	Precision 1 x 10^{-9} Min: 0, Max: 1 NA: no data
gpo	Average number of galls per acorn-cup (named object)	Floating point	Precision 1 x 10^{-9} Min: 0, Max: 3.22 NA: no data
aps	Estimated number of acorns per shoot produced in a tree. Calculated by multiplying the number of objects per shoot (ops) by the proportion of objects or acorn-cups not infected by Knopper galls	Floating point	Precision 1 x 10^{-9} Min: 0, Max: 2.46 NA: no data
pgs	Estimated number of Knopper galls per shoot in a tree. Calculated by multiplying the number of objects per shoot (ops) by the average number of galls per object	Floating point	Precision 1 x 10^{-9} Min: 0, Max: 2.22 NA: no data
shoots2	Number of shoots examined to measure primary and lammas growth and defoliation	Integer	Count Min:0, Max: 55 NA: no data
primary	Average primary shoot length	Floating point	Units: cm Precision variable Min: 1, Max: 20.07 NA: no data
lammas	Average lammas shoot length	Floating point	Units: cm Precision: variable Type: real Min: 0, Max: 35.85
prop_lammas	Proportion of examined shoots that exhibited lammas growth	Floating point	Precision 1 x 10^{-9} Min: 0, Max: 0.97 NA: no data
damage	Average defoliation score. Score from 7-point logarithmic scale (score = % leaf area lost) 0 = none; 1 = 1 - 3%; 2 = 4 - 10%; 3 = 11 - 24%; 4 = 25 - 49%; 5 = 50 - 99%; 6 = 100%	Floating point	Precision variable Min: 0.5, Max: 5.5 NA: no data
collector	Name code of person responsible for collection and entry of data	String	Nominal Code included in table NAMECOL

Data anomalies	
	In 2001 oaks 15, 22 and 27 have values 0.1 for number of shoots with 1 peduncle. This means that none of the surveyed shoots had peduncles but a few of non-surveyed shoots in the tree had. Therefore for this year 0.1 means "presence" of peduncles in the tree. Values of 0.1 appear in "**oak_acorns_acorns.csv** " for 2001 but the decimals were removed for the

	column 'shoots1' in **"oak_acorns_summary.csv"**.

Supplemental descriptors	
Publications	4
Order	By year of publication
	Crawley MJ, Akhteruzzaman M (1988) Individual variation in the phenology of oak trees and its consequences for herbivorous insects. *Functional Ecology* 2: 409–415. http://www.jstor.org/stable/2389414 Keywords: Phenology, herbivores, *Quercus robur*, individual variation
	Hails R, Crawley M (1991) The Population Dynamics of an Alien Insect: *Andricus quercuscalicis* (Hymenoptera: Cynipidae). *Journal of Animal Ecology* 60: 545–561. http://www.jstor.org/stable/5297 Keywords: acorn, insect herbivory, *Quercus*, Knopper gall
	Crawley MJ, Long CR (1995). Alternate bearing, predator satiation and seedling recruitment in *Quercus Robur* L . *Journal of Ecology* 83: 683–696. http://www.jstor.org/stable/2261636 Keywords: acorn, herbivory, mast-fruiting, Quercus, predator saciation, seed limitation.
	Crawley MJ (2005). Silwood Park and its history. In: Crawley MJ, ed. The Flora of Berkshire. Harpenden, Hertfordshire, UK: Brambleby Books, 215–253 Keywords: Silwood Park long-term experiments, rabbit's grazing history at Silwood Park
How to cite database	Contact c.estrada@imperial.ac.uk
How to acknowledge dataset	Contact c.estrada@imperial.ac.uk
Additional information	-A map is available (oak_acorn_map.pdf) - Tree pictures are available (oak_acorn_oaks.pdf)