Blossom over Time

Interim Report

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1. Background and Rationale

1.1 In 2020 the National Trust piloted the #BlossomWatch campaign, with a full launch in 2021, encouraging people to 'share the hope and joy that blossom brings'.

1.2. As part of the 2022 campaign, and to support the organisation's ambitions for nature, people and tackling climate change, the National Trust sought to understand how the blossom in people's lives and landscapes – particularly embodied in orchards – has changed over time. In doing this, the Trust aims to gain an understanding of:

- National and regional variations in the extents of orchards over time, quantifying loss, survival and creation – and the implications of this for landscape character, habitats for nature and access to blossom for people.

- The drivers for change, examining the land use types which have replaced orchards – creating opportunities for further research to help unpick *why* the landscape of blossom has changed.

- How we can think about the opportunities to bring blossom back, for nature and people, based on an understanding of the past.

1.3. Historic mapping provides a point-in-time snapshot of the different landscape types across this country, and includes distinctive symbols for certain land use types – such as orchards. However, this rich source of information is 'locked up' in images. In order to intelligently interrogate the data in these historic maps, features of interest must be individually digitised to capture their extent and location so they can be compared against modern datasets. Ordinarily this would involve a time-consuming and painstaking manual process.

1.4. However, the development of Artificial Intelligence (AI) approaches to the analysis of imagery presents an opportunity to 'detect' features of interest with much greater speed and at greater scales than ever before.
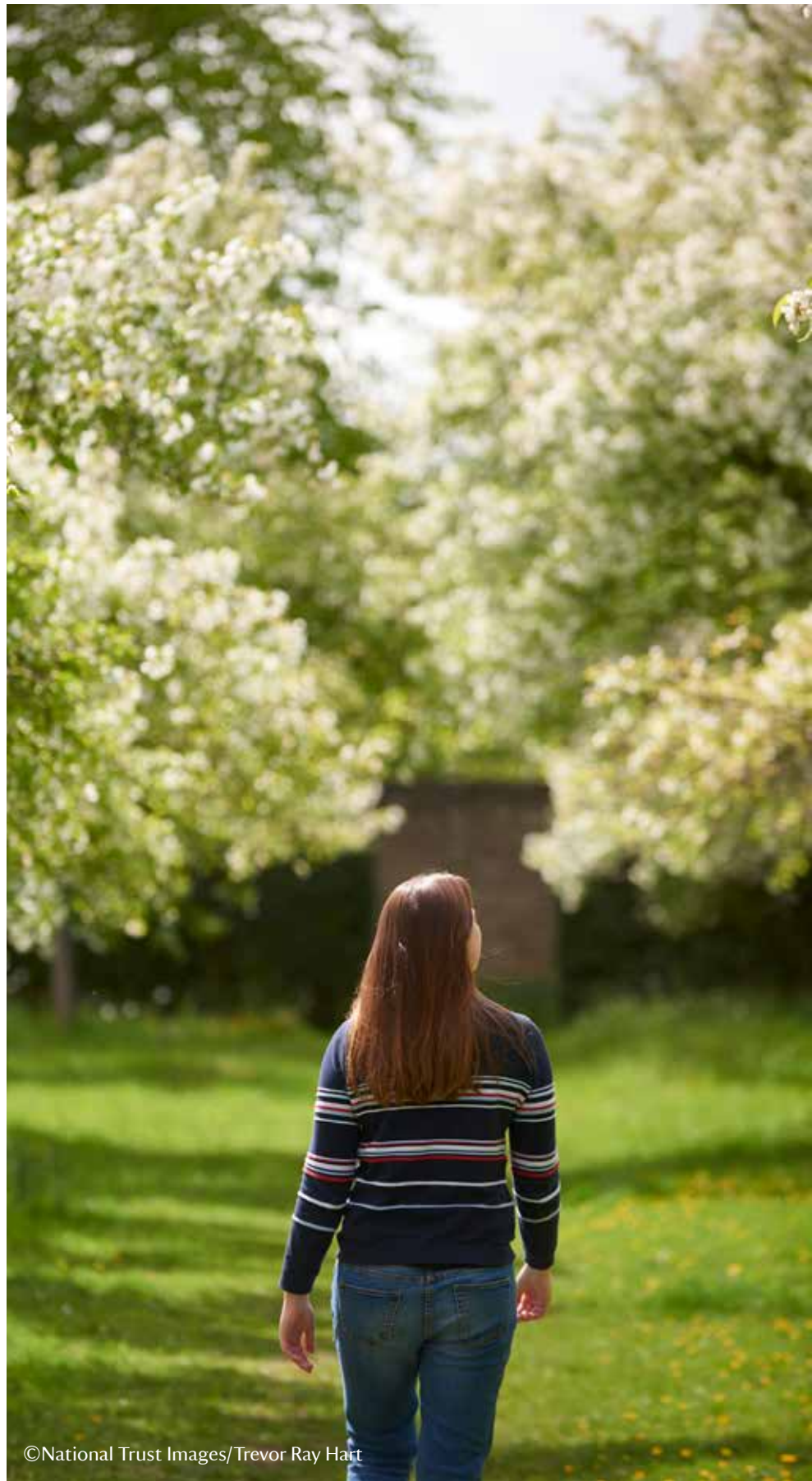
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2. Methodology

Historic Mapping

2.1. Historic mapping exists at various levels of detail, with different geographic coverage, representing different time periods and available in different formats. The Ordnance Survey 25 Inch 1892-1914 map series was identified as the most appropriate mapping to use for the purposes of this research, based on:

- Time period – providing a snapshot at the beginning of the 20th Century.

- Resolution – initial testing showed that mapping at lower resolutions (such as the 1:10560 Ordnance Survey map series dating 1949-70) did not provide sufficient detail to identify orchards consistently using an AI approach.

- Digital availability – the paper sheets of this map series have, to a large extent, been digitised and georeferenced through the National Library for Scotland, making them suitable for digital analysis with an AI approach.

- Coverage – available for the majority of Great Britain, with over 90% coverage for England. While only around 30% coverage is available for Wales, many of the areas lacking coverage are upland zones where orchards would be unlikely to have ever grown.

Artificial Intelligence Detection

2.2. Detection of orchard features from the historic mapping was delivered by ArchAI Ltd, building on previous work applying AI methods to the detection of archaeological earthworks from remote sensing data.

2.3. A training dataset (based on a randomly selected set of 353 1km² grids, within which all orchards were manually recorded and including examples with no orchards) was developed to 'teach' the AI the patterns and symbols which represent orchards (particularly their distinctive gridded pattern) – an approach known as 'image segmentation' (see Figure 1). The AI recognition is constantly updated in a trial and error process using a validation dataset, allowing it to determine if the solutions it is applying are suitable, and ensuring it is consistently improving over time.

2.4. The segmentation approach achieved a recall of 0.791 and precision of 0.738 (where a score of 1 would reflect complete accuracy of locations and spatial extents respectively). In some instances the AI returned detections of gridded patterns which were not orchards, but had emerged by chance, for instance in the mapping of other deciduous woodland. A 'template matching' method – recording the specific orchard tree symbol – was applied in addition to the image segmentation, and an 'object detection' approach (ensuring recognition of orchard tree symbols as related groups – see Figure 2) was applied to give a 'confidence' level for the segmentation results.

Understanding Change and Continuity

2.5. The results of the AI detections were compared to modern distributions of orchards and modern land use types within a 'Geographic Information System' in order to build a picture of the nature and extent of change over time.

2.6. Distributions of surviving 'traditional orchards' in England and Wales were available through the 'Traditional Orchard HAP' mapping through Natural England and Natural Resources Wales.

Figure 1: Example of training data (manual reworking of orchards in 1km² tiles) used for the AI.

Figure 2: Template matching (identification of individual orchard symbols - shown in red) used to support the identification of orchard areas by the AI.

Traditional orchards have a particularly high habitat value and are known to provide many benefits to nature – benefits which all orchards recorded in 1892-1914 are highly likely to have delivered.

2.7. The identification of a 'Modern Orchards' dataset (those orchards in existence today which fall outside the definition of 'traditional orchards', largely as a result of their more intensive management, but which still contribute to the blossom in our landscapes) was possible through comparison of the 'Traditional Orchard HAP' with modern Ordnance Survey mapping of all orchards.

2.8. The survival of orchards recorded from the 1892-1914 map series was established by examining their intersection with the 'Traditional Orchard HAP' (to show where orchards survived and continued to be managed in ways similar to how they would have been at the beginning of the 20th Century) and the mapping of modern orchards (to identify where orchards from 1900 had been 'subsumed' into modern orchards, and therefore likely losing much of their value for nature).

2.9. For orchards 'lost' since the 1892-1914 mapping (i.e. those orchards which were not represented in the 'Traditional Orchard HAP' or the 'Modern Orchards' dataset) an understanding of the current land use was derived from the United Kingdom Centre for Ecology and Hydrology Land Cover 2020 mapping. While the current land use does not definitively show the land use which replaced an individual 'lost' orchard (land use may have changed several times since the initial loss of an orchard until now), it does provide an indication of the pressures which may have driven loss of orchards at regional and national scales.

3. Results and Discussion

3.1. The AI identified over 200,000 orchard areas from historic mapping in England and Wales, covering nearly 100,000Ha. Comparison of these results with modern distributions of orchards (see Appendix 1 for full details) indicates:

- The loss of the vast majority of orchards recorded from 1892-1914. While some additional 'traditional

orchards' have been established since 1914, only around 6% of pre-1914 orchards are represented in the 'Traditional Orchard HAP' data today.
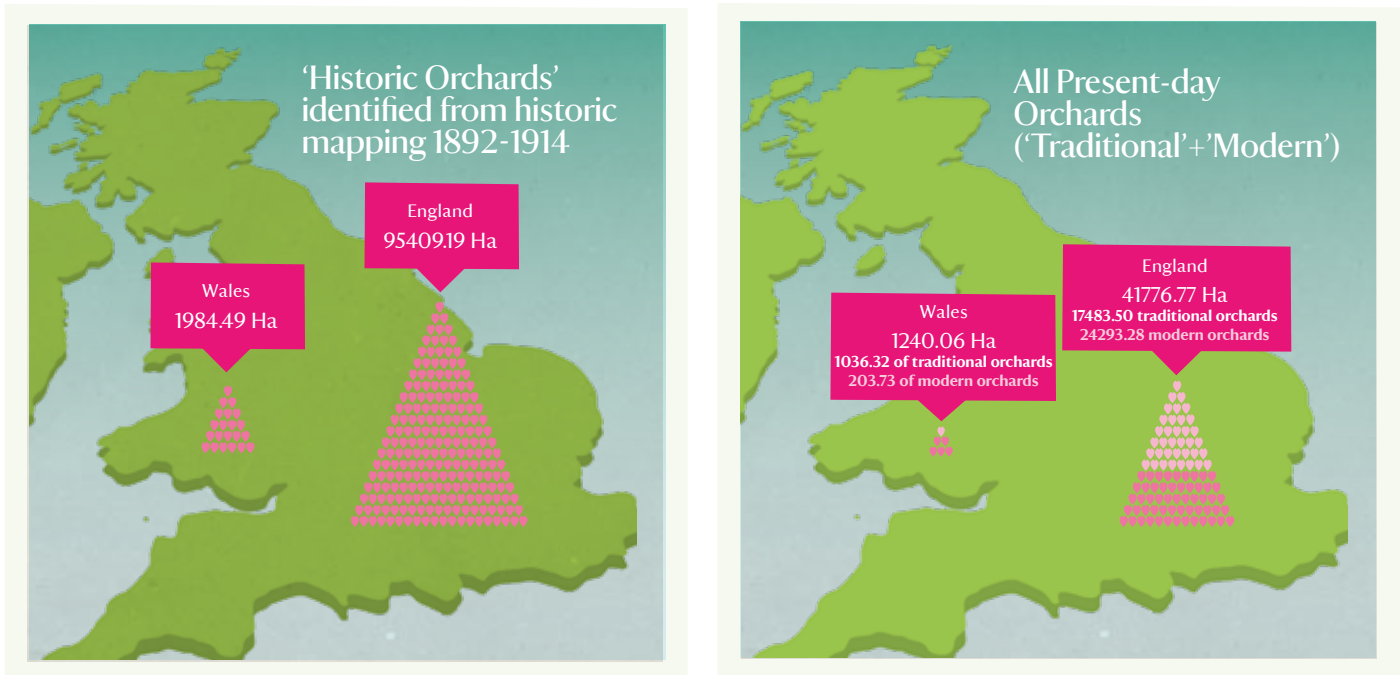
- The decline of 'traditional orchards' (i.e. those orchards which provide particular benefits to nature) in our landscapes. There are nearly 80,000Ha fewer of 'traditional orchards' in England and Wales

today. Data from Wales – though only representing a sample of the country - and with a much smaller number of orchards identified in total from 1892-1914 mapping – seems to indicate that 'traditional orchards' have fared much better than in England, with a decrease of less than 50% (as opposed to a decrease of over 80% in England).

- The decline of blossom (from orchards) in our landscape overall, from nearly 100,000Ha of orchards recorded 1892-1914 to under 50,000Ha of orchards in total in the landscapes of England and Wales today (see Figure 3 for volume and Figure 4 for density of orchards).

	Orchards Recorded 1892-1914 (Ha)	Present-day 'Traditional Orchards' (Ha)	All Present-day Orchards ('Traditional'+ 'Modern') (Ha)
England	95,409.19	17,483.50	41,776.77
Wales	1,984.49	1,036.32	1,240.06

Figure 3: The decline of blossom (from orchards) in our landscape

'Historic Orchards' identified from historic mapping 1892-1914

England
95409.19 Ha

Wales
1984.49 Ha

All Present-day Orchards ('Traditional'+'Modern')

England
41776.77 Ha
17483.50 traditional orchards
24293.28 modern orchards

Wales
1240.06 Ha
1036.32 of traditional orchards
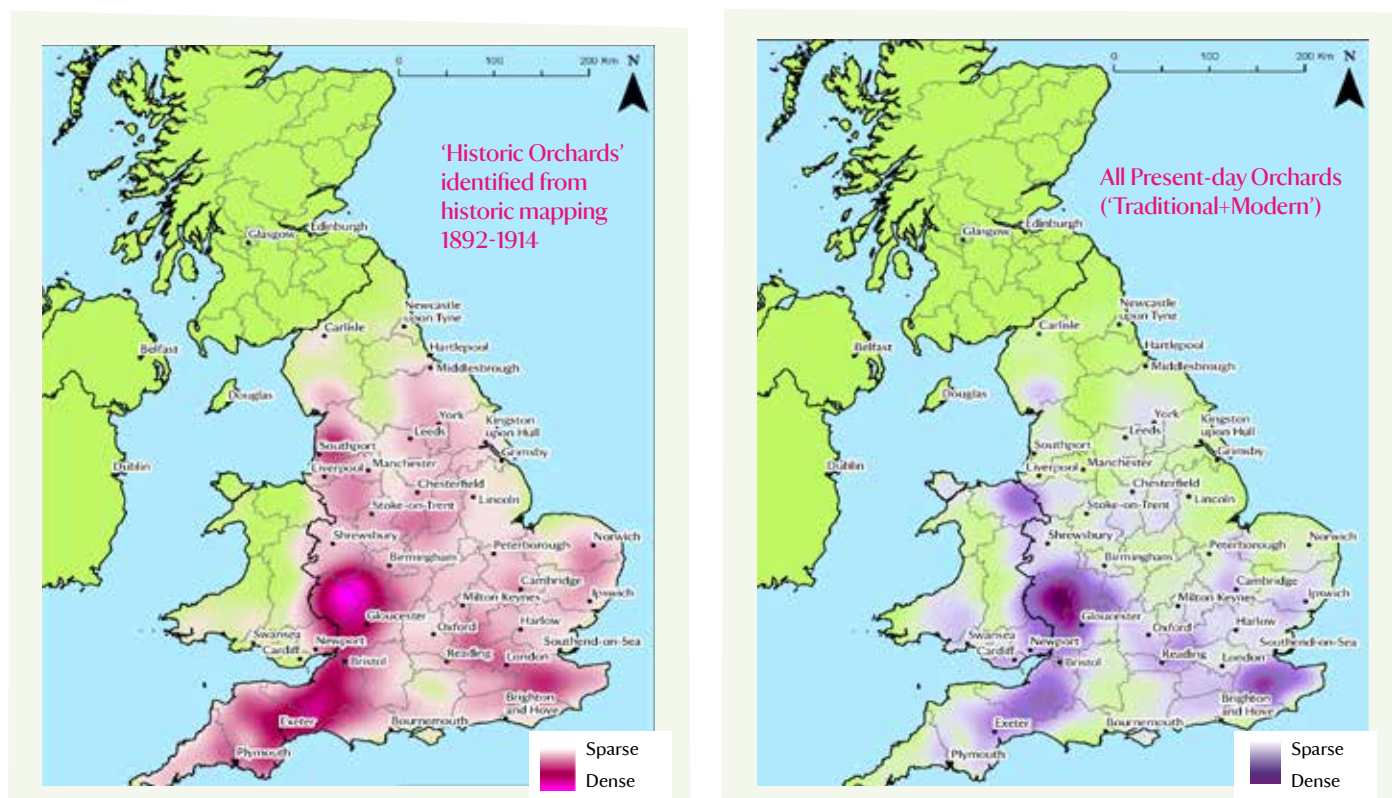203.73 of modern orchards

Figure 4: 'Heat maps' of England and Wales showing the density of orchards detected from 1892-1914 historic mapping (left) and present-day orchards (both 'traditional orchards' and 'modern orchards' combined)

- The loss of orchards to other land uses, which may be particularly linked to:

  - Urban and suburban growth. The areas currently occupied by English cities contained around 5,500Ha of orchards based on the 1892-1914 historic mapping, but those same areas include just under 250Ha of orchards today. In areas like the East Midlands, suburban and urban land use types occupy over 50% (some 1600Ha) of the land which was once given over to orchards in the region.

  - Switching to other agricultural uses of the land – particularly the creation of 'improved grassland' (which now occupies 44% of the land from 'lost' orchards in England and 57% in Wales) for livestock, and arable land use (see Figure 5).

- Strong regional variations in the loss, survival and creation of orchards since 1900. For instance, the total number of orchards in the South East (excluding London) is only around 14% lower than recorded from the 1892-1914 historic maps – compared to the national average decline of 56%. This is largely thanks to the presence of more modern (intensively managed) orchards, particularly concentrated in Kent which is one of only three English counties (along with Suffolk and East Sussex) that have more orchards now than they did 100 years ago.

- Conversely the South West region, home to the largest area of orchards at the beginning of the 20th Century, has experienced the loss of 74% - nearly

24,000Ha – of its orchards, the single biggest loss in terms of hectares of any region.

3.2. These results provide the basis for further work to understand the social and cultural histories of orchards in different regions and landscapes, which may help us to understand drivers of change in more detail, and may also help to identify opportunities to restore or establish new orchards for people and nature.

3.3. The successful application of an AI approach to the detection of orchards on historic mapping suggests there may be opportunities to extend this methodology to examine other aspects of historic land use– for instance, understanding the extents of historic hedgerows or woodland cover.

3.4. While the AI approach has produced results with relatively high confidence levels, there will be opportunities to refine and enhance the data, potentially through crowd-sourcing/ citizen science approaches.

3.5. There will be opportunities to expand this research geographically (enhancing coverage for Wales, extending coverage to Northern Ireland), and a more detailed picture of change over time could be delivered through analysis of mid-20th Century mapping, if historic mapping at a suitable resolution can be identified.
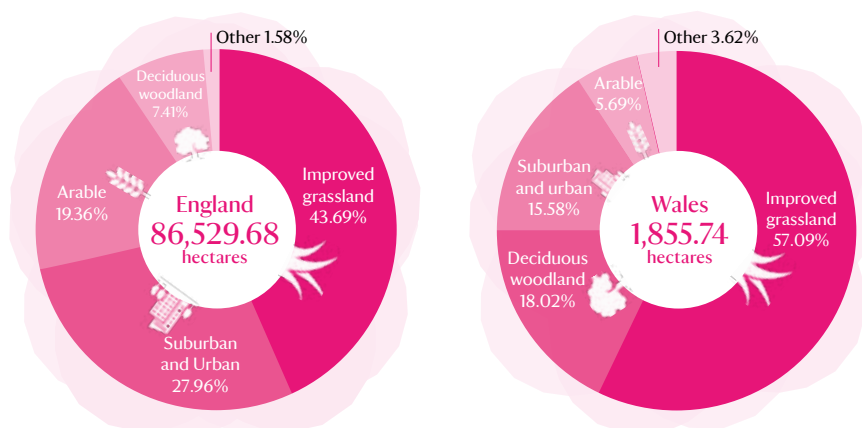

Figure 5: Land use change for the loss of blossom

Appendix 1

		Orchards recorded 1892-1914 (Ha)	Present-day 'Traditional Orchards' (Ha)	Present-day 'Modern' Orchards (Ha)	All Present-day Orchards (Ha)
Country	England	95409.19	17483.50	24293.28	41776.77
	Wales	1984.49	1036.32	203.73	1240.06
Region	London	2550.00	132.58	30.00	162.59
	North East	395.90	50.96	35.75	86.72
	North West	2625.73	406.41	107.42	513.83
	Yorkshire and The Humber	2207.44	356.92	141.3	498.22
	South West	32338.95	5635.22	2759.75	8394.97
	South East	17415.05	3144.48	11766.21	14910.69
	East Midlands	3326.51	628.55	306.47	935.01
	West Midlands	27500.89	5281.65	6748.67	12030.32
	East of England	7048.71	1846.72	2397.71	4244.43
County	Greater London	2550.00	132.58	30.00	162.59
	Merseyside	146.39	8.82	3.02	11.84
	Bristol	136.93	13.03	0.31	13.34
	Lancashire	1069.19	91.53	15.85	107.38
	Greater Manchester	280.96	22.63	11.15	33.78
	Durham	191.21	19.00	4.18	23.18
	Wiltshire	1476.78	122.98	86.30	209.28
	West Midlands	387.02	57.92	6.36	64.29
	Leicestershire	546.88	44.38	59.20	103.58
	Tyne & Wear	26.90	3.42	1.75	5.16
	Surrey	1061.00	149.95	54.40	204.34
	Dorset	1894.33	202.98	181.80	384.78
	Cornwall	1648.38	275.87	62.04	337.91
	Devon	9058.63	1382.72	593.44	1976.16
	North Yorkshire	1187.58	198.04	62.94	260.98
	Rutland	55.47	11.38	1.11	12.49
	Shropshire	1984.23	342.01	108.98	450.99
	Derbyshire	602.71	110.96	27.72	138.68
	East Riding of Yorkshire	383.96	58.15	32.73	90.88
	South Yorkshire	270.94	35.62	29.26	64.87
	Staffordshire	604.83	103.27	49.20	152.47
	West Yorkshire	240.44	49.00	13.84	62.85
	Mid Glamorgan	35.28	8.79	0.45	9.24
	Worcestershire	11258.78	2023.29	995.61	3018.90
	Cheshire	636.87	119.10	54.02	173.11
	Warwickshire	1325.01	243.72	117.03	360.75
	Gloucestershire	8381.75	1702.19	626.19	2328.38
	Lincolnshire	858.17	159.86	79.47	239.33
	Nottinghamshire	820.69	180.61	53.03	233.64
	Hertfordshire	785.36	203.04	44.12	247.16
	Buckinghamshire	1445.89	368.26	88.06	456.32
	Somerset	9742.15	1935.46	1209.67	3145.12
	Northamptonshire	627.09	144.82	90.05	234.87
	Cumbria	492.33	164.33	23.38	187.71
	Berkshire	491.89	129.39	67.73	197.12
	Northumberland	117.81	21.20	28.24	49.44
	Cambridgeshire	2459.52	584.69	509.39	1094.08
	Oxfordshire	802.57	257.41	111.89	369.31
	Gwent	1164.25	502.96	103.36	606.32
	West Sussex	631.17	172.26	167.58	339.84
	Bedfordshire	397.74	127.29	93.38	220.67
	Dyfed	229.98	102.54	28.24	130.79
	Powys	444.19	223.42	38.27	261.69
	Norfolk	1664.98	405.10	624.72	1029.83
	Herefordshire	11941.03	2511.45	5471.48	7982.93
	Hampshire	726.97	170.39	341.75	512.14
	Essex	871.52	362.90	411.06	773.97
	Isle of Wight	62.09	44.66	13.10	57.76
	Suffolk	869.58	163.69	715.04	878.73
	Kent	11561.14	1706.25	10320.86	12027.12
	East Sussex	632.33	145.91	600.83	746.75
	Gwynedd	46.27	50.03	9.42	59.45
	West Glamorgan	20.02	22.91	3.19	26.11
	South Glamorgan	17.68	25.62	8.56	34.18
	Clwyd	26.81	100.04	12.24	112.28

Table 2:
Historic and present-day orchard area extents by city

Reflects the top 10 major towns and cities which have experienced the greatest loss (in hectares) of orchards, based on the area of historic orchards identified from 1892-1914 mapping within the modern boundary extents of cities ("Major Towns and Cities (December 2015) Boundaries"), in contrast to the area of all present-day orchards within those same extents.

City	'Historic Orchards' identified from historic mapping 1892-1914 (Ha)	Present-day 'Traditional Orchards' (Ha)	Present-day 'Modern Orchards' (Ha)	All Present-day Orchards ('Traditional'+ 'Modern') (Ha)
London	2146.65	52.76	2.31	55.07
Maidstone	343.25	2.70	9.08	11.78
Cheltenham	294.33	3.31	0.12	3.43
Gillingham	246.51	4.06	6.38	10.44
Gloucester	183.14	3.43	0.29	3.72
Bristol	183.32	6.57	0.28	6.85
Birmingham	186.15	29.29	0.58	29.87
Worcester	157.73	1.93	0.02	1.95
Exeter	146.36	3.10	0.79	3.89
Woking	127.94	1.06	0	1.06

Table 3:
Modern land use of 'lost' historic orchards

Column One

Identifies the hectarage of modern land use type (according to UKCEH Land Cover 2020) for all areas of orchards identified from 1892-1914 historic mapping which are not represented in either the Traditional Orchard HAP datasets for England and Wales or the mapping of 'modern' orchards.

Column Two

Identifies the percentage of all 'lost' orchard areas (within the relevant geographic area) which are now occupied by the particular land use type.

The modern land use recorded for an area of 'lost' orchard does not necessarily mean that the orchard area in question was replaced by that land use type – land use types may have changed several times since the original loss of an orchard.

	Hectares of 'lost' orchard from 1900 to now (not including those subsumed into 'modern' orchards) occupied by other land use types	% of all 'lost' orchards from 1900 (not including those subsumed into 'modern' orchards) now occupied by other land use types'
England	**86529.68**	
Improve grassland	37806.55	43.69%
Suburban	21766.30	25.15%
Arable	16750.11	19.36%
Deciduous woodland	6414.13	7.41%
Urban	2431.03	2.81%
Neutral grassland	307.46	0.36%
Saltmarsh	275.45	0.32%
Freshwater	210.31	0.24%
Coniferous woodland	148.42	0.17%
Calcareous grassland	135.07	0.16%
Acid grassland	75.22	0.09%
Littoral sediment	47.02	0.05%
Supralittoral sediment	42.64	0.05%
Fen	32.36	0.04%
Heather grassland	26.19	0.03%
Inland rock	22.88	0.03%
Heather	16.24	0.02%
Bog	8.71	0.01%
Saltwater	7.35	0.01%
Supralittoral rock	3.14	0.00%
Littoral rock	3.11	0.00%
Wales	**1855.74**	
Improve grassland	1059.43	57.09%
Deciduous woodland	334.32	18.02%
Suburban	267.24	14.40%
Arable	105.64	5.69%
Urban	21.99	1.18%
Acid grassland	20.63	1.11%
Neutral grassland	11.52	0.62%
Coniferous woodland	10.52	0.57%
Saltmarsh	4.49	0.24%
Heather grassland	4.31	0.23%
Supralittoral rock	4.19	0.23%
Supralittoral sediment	3.88	0.21%
Freshwater	2.88	0.16%
Heather	1.31	0.07%
Fen	1.01	0.05%
Littoral sediment	0.80	0.04%
Inland rock	0.74	0.04%
Saltwater	0.62	0.03%
Littoral rock	0.21	0.01%

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