

Appendix 1 – Cotswolds AONB Natural Capital Assets

Assets	Description, quantity, quality and trends	Issues and opportunities
Geology	<p>The Cotswolds are part of an Oolitic limestone belt that stretches for nearly 300 miles from Dorset to North Yorkshire - and form part of an outcrop of Jurassic rock laid down between 200 and 145 million years ago. (Oolite is the type of rock formed largely of layers of calcite that have been deposited around tiny particles such as a sand grain or fossil fragment and are rolled back and forth in warm, shallow sea.)</p> <p>The western edge of the Cotswolds is a steep escarpment, rising to 330 metres above sea level, overlooking the Severn Valley and the Vale of Evesham. It provides a magnificent backdrop to places like Bath, Cheltenham and Gloucester. Historic villages shelter under the escarpment edge and ancient forts guard its crest.</p> <p>To the South East the land dips away with rolling wolds and river valleys – making the Cotswolds a classic example of a ‘scarp and dip’ landscape. The river valleys have developed over the last 12,000 years, whereas the dip of the rocks was in place some 60-25 million years ago.¹</p>	<i>Not relevant</i>
Soils	<p>The underlying limestone geology (Jurassic limestone and clay) results in calcareous (lime-rich) soils. The Sherborne association is extensive in South West England and covers over 1000 km² on the Cotswolds in Avon, Wiltshire and Gloucestershire, and extends south through East Somerset into Dorset on similar limestones.</p> <p>Small areas of fine loamy rendzinas of the Elmton series are included on the Cotswold plateau, and Marian soils occur on the steep scarp and on the valley sides incised into the dip slope. Narrow dry valleys are floored with limestone drift and colluvium and have Didmarton soils. The larger valleys have floodplains with wet clayey alluvial soils.</p>	<p>Issues:</p> <ul style="list-style-type: none"> • Shallow lime-rich soils over limestone are particularly vulnerable to leaching of nitrate and pesticides to groundwater • Lack of soil moisture is the most likely limiting factor to yields. • Lime-rich loamy and clayey soils can be subject to compaction and poaching.

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	<p>On the high wold and dip slope, shallow lime-rich soils over limestone predominate (Soilscape 3)². The Sherborne association comprises shallow well drained brashy calcareous clayey soils over limestone³. Top soil carbon is low to medium. Fertility is lime-rich, suitable for arable (cereals) and (short term and permanent) grassland (dairying and stock rearing).</p> <p>In the valley bottoms, there are lime-rich loamy and clayey soils with impeded drainage (Soilscape 9)⁴ amongst other soil types. Top soil carbon is low, but fertility is high.</p> <p>82.7% of the agricultural land in the AONB is Grade 3. 6.4% of the agricultural land in the AONB is Grade 4.⁵</p>	<p>Opportunities:</p> <ul style="list-style-type: none"> • Improve soil structure and quality by increasing organic matter content such as changing crop rotation, use of break crops and temporary grass.
Fresh water - Aquifer	<p>An aquifer is a permeable rock that stores groundwater. The aquifer under the Cotswolds is a 'Principal Aquifer', as defined by the Environment Agency, meaning that it provides a high level of water storage, and supports water supply and river base flow on a strategic scale.⁶ The River Thames originates from the springs from the limestone of the Cotswold Hills.⁷</p> <p>The Cotswolds aquifer (Corallian Limestone) is up to 40 m thick, gives yields of 5 to 10 l/sec.⁸ The Cotswolds is home to a massive aquifer supplying water to London. It is estimated that the AONB supplies Thames Water with 500 million litres of water a day - equivalent to 3.2 St Pauls Cathedrals.⁹ Data on the Cotswolds aquifer, its volume and production etc., is not currently available from the Environment Agency but has been requested.</p> <p>The quality of water from the Jurassic limestones is generally good, but hard with calcium and bicarbonate ions predominating.¹⁰ Groundwater sources need to be looked after to ensure that the water is completely safe to drink. This includes the use of Source Protection Zones for groundwater sources such as wells, boreholes</p>	<p>Issues:</p> <ul style="list-style-type: none"> • Abstraction from the main Inferior Oolite public supply sources at Baunton, Meysey Hampton (just outside AONB boundary) and Bibury have a rapid and significant effect on river flows.¹⁰ • Abstraction from the confined portion of the limestone aquifers in the Cotswolds has to be very carefully monitored during the summer months to ensure their impact on streamflows is minimised. This abstraction also reduces peak winter flows, by decreasing groundwater discharge and making the streams less 'flashy'.¹⁰ • Leaching of nitrate and pesticides to

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	<p>and springs used for public drinking water supply. Groundwater Protection Policy identifies pollution prevention measures in areas which are at a higher risk and monitors the activities of potential polluters nearby.¹¹</p>	<p>groundwater</p> <p>Opportunities:</p> <ul style="list-style-type: none"> • Manage abstraction carefully to maintain ecological flow levels, especially in periods of low flow. • Careful and optimal land management around groundwater sources.
Fresh water - Rivers	<p>The River Thames has its source in the Cotswolds and includes the principal Thames tributaries of the Evenlode, Windrush, Leach, Coln and Churn as well as the source of the Thames and the key Oolitic limestone aquifer.¹²</p> <p>The rivers are fed by springs from the limestone of the Cotswold Hills and drop about 180 m to the floodplain of the River Thames where they flow over clay overlain by sand and gravel deposits. The furthest West joining the Thames close to its headwaters are the River Coln, Ampney Brook and the River Churn. To the North East are the River Leach, the River Windrush and the River Evenlode. The area is part of the Thames basin.¹³</p> <p>The Environment Agency has been establishing projects within the AONB to improve the ecological condition of the rivers. Catchment Management Plans (CMP) provide the actions needed to achieve good ecological condition.</p> <p>Water Framework Directive (WFD) data for 2016 gives the figure of 206,715 metres of monitored river lengths as being in good ecological condition in the AONB; this is 35% of the total monitored length of 592,319 metres. This figure has more meaning when set in the context of the numbers for the other conditions, see Table 1 below. A comparison with previous years shows a dramatic decrease in length of river categories as poor status and an increase in all other classes; no explanation is provided for this.¹⁴</p>	<p>Issues:</p> <ul style="list-style-type: none"> • Low flows on several rivers in the Cotswolds, notably the Windrush, Churn, Coln and the Ampney Brook.¹³ This applies especially during dry periods and restricts water available for abstraction. <p>Opportunities:</p> <ul style="list-style-type: none"> • Manage abstraction carefully to maintain ecological flow levels, especially in periods of low flow.

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	<p>Table 1: WFD ecological status of rivers within the Cotswolds AONB (length in metres) status:</p> <table><tr><th></th><th>High</th><th>Good</th><th>Moderate</th><th>Poor</th><th>Bad</th></tr><tr><td>2013</td><td>0</td><td>154,419</td><td>273,653</td><td>132,476</td><td>19,959</td></tr><tr><td>2014</td><td>0</td><td>178,636</td><td>224,458</td><td>200,704</td><td>3,308</td></tr><tr><td>2015</td><td>0</td><td>142,820</td><td>267,800</td><td>185,590</td><td>11,110</td></tr><tr><td>2016</td><td>0</td><td>206,715</td><td>304,919</td><td>9,714</td><td>70,971</td></tr></table> <p>Of 3 standing water bodies in the AONB, 2 are in good ecological condition and 1 is categorised moderate. Of 13 ground waterbodies in the AONB, 11 are in good ecological condition and 2 are categorised poor.</p> <p>The rivers in the AONB are important for water supply (see Water Supply in Appendix 2), recreation and biodiversity. The Thames and its tributaries is one of the most important environmental features of the region providing a diverse range of habitats, including a vital corridor for the migration of wildlife. These habitats all have their own particular flow and level requirements that need to be protected. ¹⁵</p>		High	Good	Moderate	Poor	Bad	2013	0	154,419	273,653	132,476	19,959	2014	0	178,636	224,458	200,704	3,308	2015	0	142,820	267,800	185,590	11,110	2016	0	206,715	304,919	9,714	70,971	
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Air	<p>Cotswolds AONB is predominantly a rural area. There are no industrial areas within the district or close by that make a significant negative impact on air quality in the Cotswold AONB. The industries within the Cotswold District that emit any of the prescribed pollutants are not located close to relevant public exposure. The scale on which they operate does not produce emissions that contribute significantly to air quality. ¹⁶</p> <p>Emissions from road traffic can have a local impact on air quality. The main traffic routes pass mainly through countryside, bypassing most of the main towns, apart</p>	<p>Issues:</p> <ul style="list-style-type: none">• Lower air quality in specific areas along main traffic routes <p>Opportunities:</p> <ul style="list-style-type: none">• n/a																														

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	<p>from the A429 that passes through the outskirts of Stow-on-the-Wold and Moreton-in-Marsh (note, this information covers Cotswolds District Council area only).</p> <p>Monitoring sites are within two Air Quality Management Areas (AQMA): the Air Balloon Roundabout in Birdlip, declared in 2008 and an area of Thames Street Lechlade, declared in 2014. Levels of NO₂ (nitrogen dioxide) remain above the National Objective. There are no national air quality monitoring sites within the AONB, although two - in Bath and Oxford - are not too far away.</p>	
Climate	<p>The Met Office website describes the climate for regions in the UK http://www.metoffice.gov.uk/climate/uk/regional-climates/mi</p> <p>The Cotswolds falls under the 'Midlands' area. Mean annual temperatures over this region vary from around 8 °C to just over 10 °C. Sharp winter frosts are common and there are occasional very hot summer days, particularly in the south (e.g. the Cotswolds) and east of the region. These temperature extremes of both winter and summer are a key characteristic of the Midlands climate. January is the coldest month, with mean daily minimum temperatures varying from just below 0 °C to about 1.5 °C. July is the warmest month, with mean daily maximum temperatures exceeding 22 °C in the south (e.g. the Cotswolds) and east Midlands.</p> <p>Average annual sunshine durations over the Midlands range from less than 1,400 hours in the higher northern and western fringes to about 1,600 hours near the southern boundary (e.g. the Cotswolds). These figures compare with values of less than 1,100 hours a year in the Shetland Islands to over 1,750 hours along the south coast of England</p> <p>In terms of rainfall, the Cotswolds receive an average of over 800 mm per year, (compared with annual totals around 500 mm in the drier parts of eastern</p>	<p>Issues:</p> <ul style="list-style-type: none"> Climate change can be expected to affect the extent and quality of different types of natural capital (e.g. soils, water, habitats and species) <p>Opportunities:</p> <ul style="list-style-type: none"> Identify and implement a range of climate mitigation and adaptation measures, for example in relation to water, soils, farmland, woodland and biodiversity.

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	<p>England). Rainfall is generally well-distributed through the year, with summer amounts there is associated showery, convective rainfall.</p> <p>The yearly number of days of snow lying at Brize Norton (close to the Cotswolds) is about 5 days, mainly during January and February.</p>	
Habitats		
Enclosed Farmland	<p>Agricultural land in the Cotswolds AONB comprises 177,415ha (87% of all land in the AONB) in 2013. The main land uses are crops and bare fallow (49% of all agricultural land), permanent grass (34%), temporary grass (8%), woodland (6%), rough grazing (1%) and other (2%).</p> <p>The AONB has a slightly higher proportion of land in crops and fallow, and temporary grass, and a slightly lower proportion of permanent grassland compared to England. The AONB has significantly more woodland on farm holdings and significantly less rough grazing compared to England.</p> <p>Crops and fallow has increased significantly since 2007 (41%), reversing a previous downward trend. The main reason for this is likely to be the removal of the set-aside requirement from 2008 onwards. Temporary grass has increased slightly since 2007 and permanent grassland and rough grazing have both decreased. There has been a slow but steady increase in the area of woodland on farm holdings (from 4% in 1990 to over 6% in 2013).</p> <p>As at the 31st March 2015 the area under agri-environment schemes in the Cotswolds AONB was 123,725ha. This represents 61% of the AONB and 80% of the estimated Utilisable Agricultural Area¹⁷.</p>	<p>Issues:</p> <ul style="list-style-type: none"> • The extent of different types of enclosed farmland can be expected to change with shifts in agricultural policy and prospects in the future (influenced by Brexit amongst other factors) • Reduced participation in agri-environment schemes can be expected with the limited budget for Countryside Stewardship. <p>Opportunities:</p> <ul style="list-style-type: none"> • Design a new policy and programmes that steward natural capital assets and rewards the provision of public goods
Woodland	<p>There is an estimated 26,370ha of woodland in the AONB (13% of all land in the AONB). Broadleaved woodland predominates, accounting for 19,558ha or 74% of all woodland. Conifers account for 2,969 or 11%, with the balance being mixed</p>	<p>Issues:</p> <ul style="list-style-type: none"> • Lack of management, particularly with small / difficult to access woodlands • Pests and diseases

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	<p>woodland, young trees etc.</p> <p>Beech and ash are the predominant broadleaved species, accounting for around 60% of broadleaved species¹⁷. Beech is prominent on the scarp and incised valleys. Mixed oak, ash, sycamore and maple tend to be concentrated on the lower slopes. There are in addition areas of lowland wood pasture and parkland, associated with large estates, and some large blocks of conifer plantation.</p> <p>Ancient woodland in the AONB covers 6,192 ha with an additional 3,292 ha of Plantations on Ancient Woodland Sites (PAWS) together they cover 9,485 ha (5% of the AONB area)¹⁷. 4,170 ha (45% of Ancient woodland within the AONB) was under Cotswolds AONB English Woodland Grant Scheme agreements with ancient woodland over 2005-2011¹⁴.</p> <p>Most new tree planting undertaken over the last 20 years has taken place on farms and has been in the form of new mixed broadleaved woodland. This has been stimulated by grant schemes, shooting and a desire for screening.</p> <p>Of this total woodland, 61% is actively managed and 39% unmanaged. Only 241 ha are in FC ownership (0.1% the of AONB area)¹⁴.</p>	<ul style="list-style-type: none"> Climate change, in terms of the effects of wind/storm damage, warmer/drier summers, etc. <p>Opportunities:</p> <ul style="list-style-type: none"> Design a new policy and programmes that steward natural capital assets and rewards the provision of public goods
Priority Habitats	<p>BAP (Biodiversity Action Plan) Priority Habitats account of 16,039ha or around 8% of the AONB area. The main BAP priority habitats include deciduous woodland (12,451ha), lowland calcareous grassland (2,827ha, including around 1,500ha Jurassic limestone grassland (CG5 upright brome/tor grass)) and lowland meadows (524ha), see Table 2 below and Figure 1 (at the end of the Appendix).¹⁸</p>	<p>See 'Plants and Animals' below</p>

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	<p>Table 2: BAP Priority Habitats in the Cotswolds AONB</p> <table><tr><th>BAP Priority Habitat</th><th>Ha</th></tr><tr><td>Deciduous Woodland</td><td>12,451</td></tr><tr><td>Lowland Calcareous Grassland</td><td>2,827</td></tr><tr><td>Lowland Meadows</td><td>524</td></tr><tr><td>Lowland Heath</td><td>93</td></tr><tr><td>Undetermined Grass</td><td>81</td></tr><tr><td>Reed Beds</td><td>49</td></tr><tr><td>Purple Moor Grass & Rush Pasture</td><td>14</td></tr><tr><td>Total</td><td>16,039</td></tr></table>	BAP Priority Habitat	Ha	Deciduous Woodland	12,451	Lowland Calcareous Grassland	2,827	Lowland Meadows	524	Lowland Heath	93	Undetermined Grass	81	Reed Beds	49	Purple Moor Grass & Rush Pasture	14	Total	16,039	
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Wildlife sites	<p>Cotswolds AONB contains many sites designated for their biodiversity, including five Special Areas of Conservation (SACs), three National Nature Reserves (NNRs), 89 Sites of Special Scientific Interest (SSSIs) and a large number of local sites. The majority of SSSIs are in favourable or favourable recovering condition, see Figure 2 (at the end of the Appendix).¹⁴</p> <p>Local Wildlife Sites (LWS) represent the vast bulk of sites important for wildlife, normally all of the known ancient habitats as well as other areas of interest. They are designated locally, do not represent a statutory designation although they can be recognised in local plans. The percentage reported to be in positive management varies from one local authority to another, from 28% to 71%. This will reflect the situation on the ground but could also be affected by lack of consistency in recording.¹⁴</p>	See ‘Plants and Animals’ below																		

Plants and animals	The Cotswolds is home to important species of birds, insects, mammals, amphibians and plants. Many are rare, and found only on limestone or calcareous soils.	<p>Issues:</p> <ul style="list-style-type: none"> • Loss of species-rich grassland due to lack of appropriate grazing • Declining farmland bird numbers, thought to be due to a decline in mixed farms • Declining woodland birds, due to a lack of management and diversity in woodland structure <p>Opportunities:</p> <ul style="list-style-type: none"> • Bring into good condition designated sites and other priority habitats, particularly through re-establishing appropriate grazing regimes alongside scrub and woodland management. • Enhance buffering, alongside extension and linking of the core of designated sites, in line with climate change adaptation and landscape-scale working principles • Improve the matrix of habitats for species of farmland birds, particularly on the high wold where arable cropping is most prevalent. • Undertake species-specific management where required, alongside habitat-based approaches
Birds	<p>BAP Priority Species (Birds) in the AONB include Corn Bunting, Curlew, Grey Partridge, Lapwing, Redshank, Tree Sparrow, Turtle Dove and Yellow Wagtail. See the distribution maps in Figure 3 (at the end of this Appendix)¹⁹. Some species are reasonably widespread across the area, others (such as Curlew, Redshank and Turtle Dove) are restricted to relatively few key areas.</p> <p>In terms of other bird species, Skylarks are widespread and there are good numbers of Redstarts, Tree Pipits and Spotted Flycatchers, and small pockets of Grasshopper Warblers and Stonechats. The area also supports a very high population of Buzzards – possibly as great a concentration as anywhere in Britain – and there are a few Hobby, Peregrine and Goshawk nesting areas, and it is hoped that Red Kites will be proven to have bred here soon.²⁰</p>	
Insects	<p>BAP Priority Species (Insects) in the AONB include Pearl Bordered Fritillary, High Brown Fritillary and Marsh Fritillary. See the distribution maps in Figure 3²¹. Some species are reasonably widespread across the area, others (such as Marsh Fritillary) are restricted to a few key areas.</p> <p>The best sites for uncommon butterfly species in the area are mostly on unimproved grasslands, open woodlands, and old industrial sites particularly disused quarries and railway lines. A common feature of such sites is very shallow soil and short, sparse vegetation grazed by rabbits and deer perhaps, but usually not by sheep or cattle. They can also be quite sheltered, so they provide a hotter microclimate than more open areas with more vegetation. Some of the lakeside habitat in the Cotswold Water Park (created by gravel extraction) is good for some butterfly species.²²</p>	
Mammals	BAP Priority Species (Mammals) in the AONB include Water Vole, Otter and Greater Horseshoe Bat. See the distribution maps in Figure 3 ²³ . Water Vole is	

	reasonably widespread whereas Greater Horseshoe Bat and particularly Otter are restricted in area.	
Amphibians	BAP Priority Species (Amphibians) in the AONB include Great Crested Newt, see the distribution map in Figure 3.	
Plants	BAP Priority Species (Plants) in the AONB include Early Gentian, see the distribution map in Figure 3.	

Figure 1: BAP Priority Habitats in the Cotswolds AONB

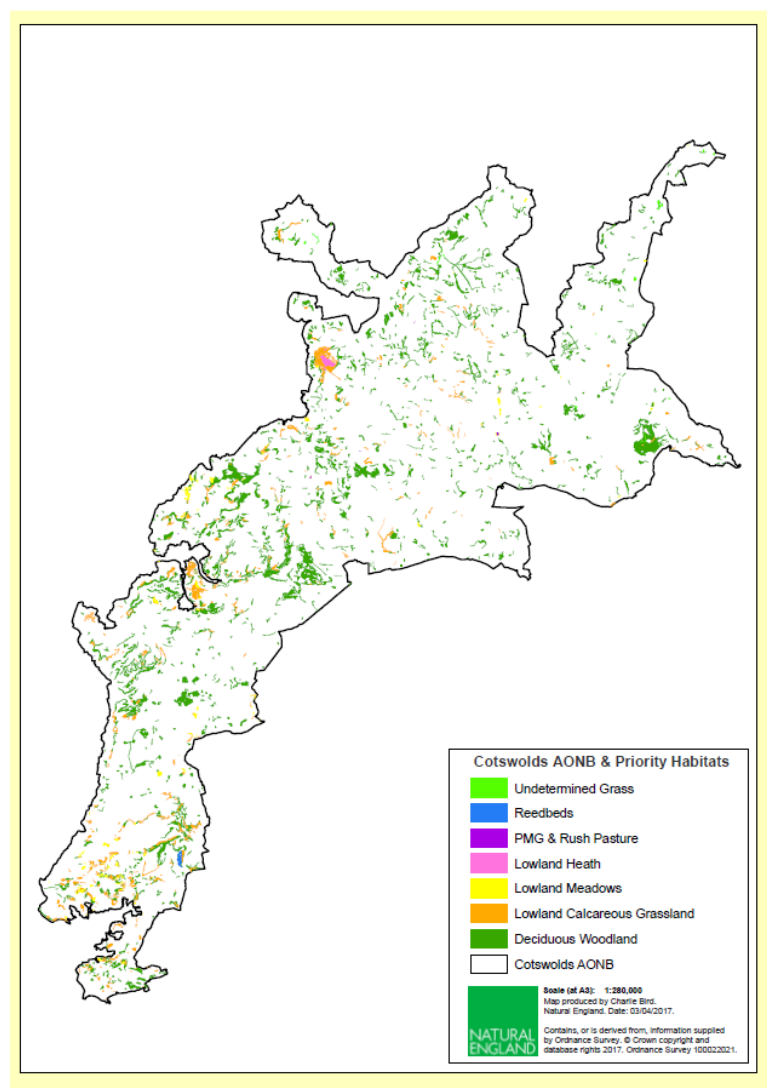


Figure 2: SSSI condition by broad habitat in the Cotswolds AONB

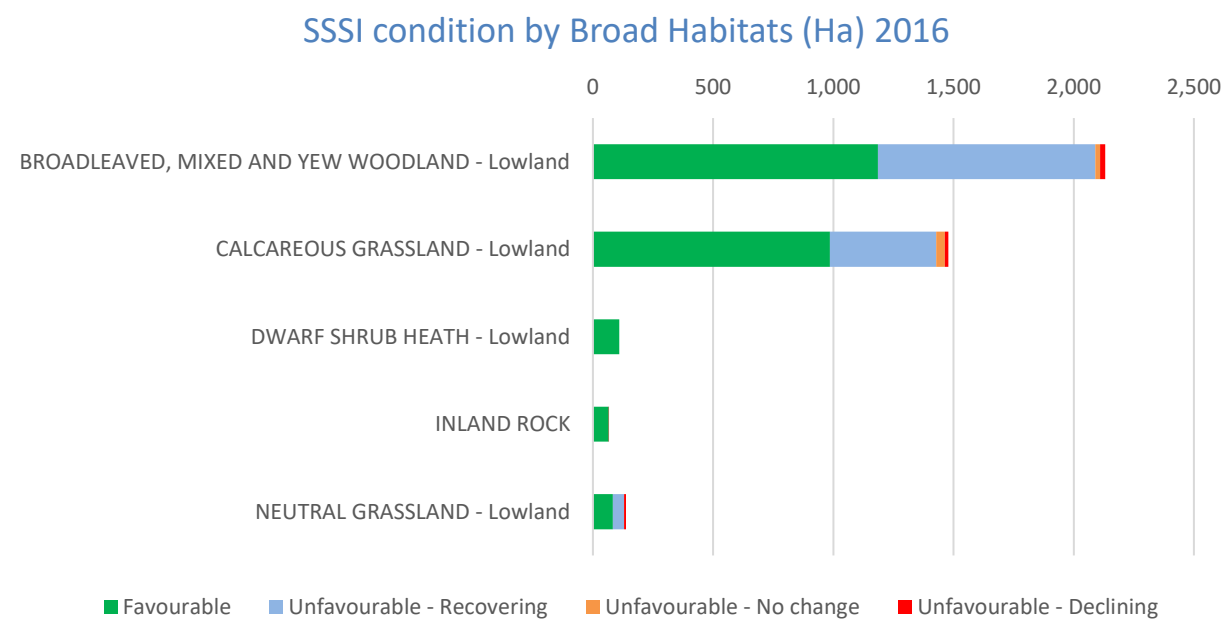
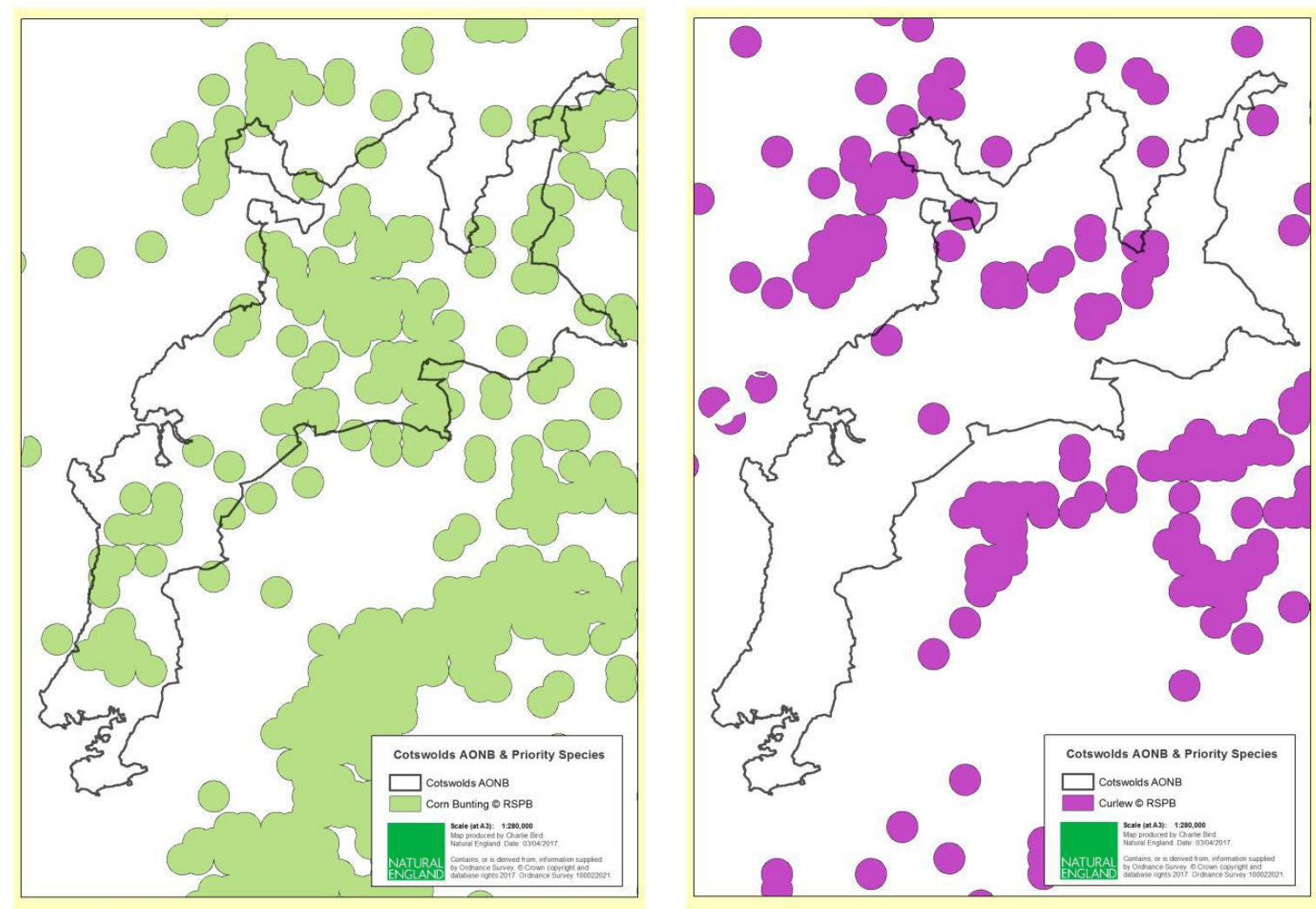
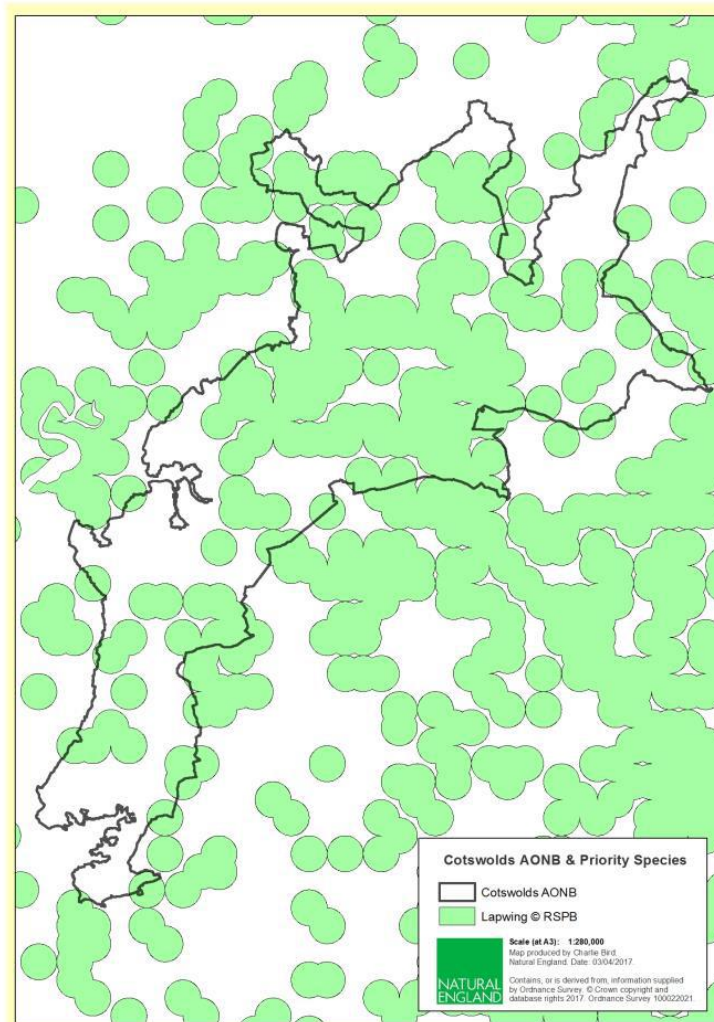
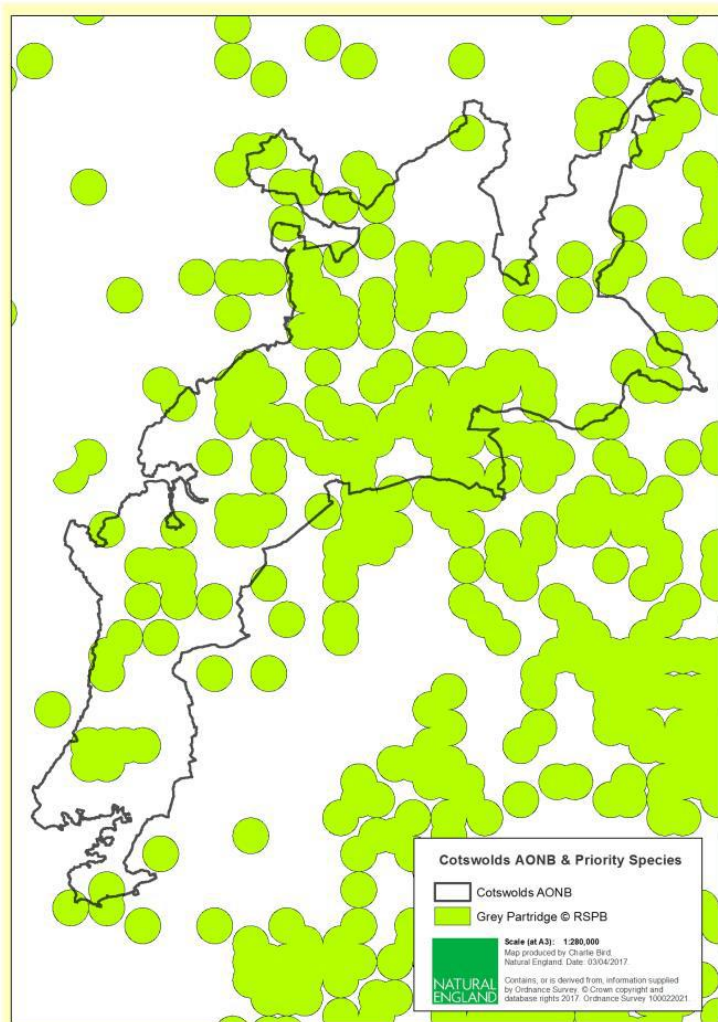
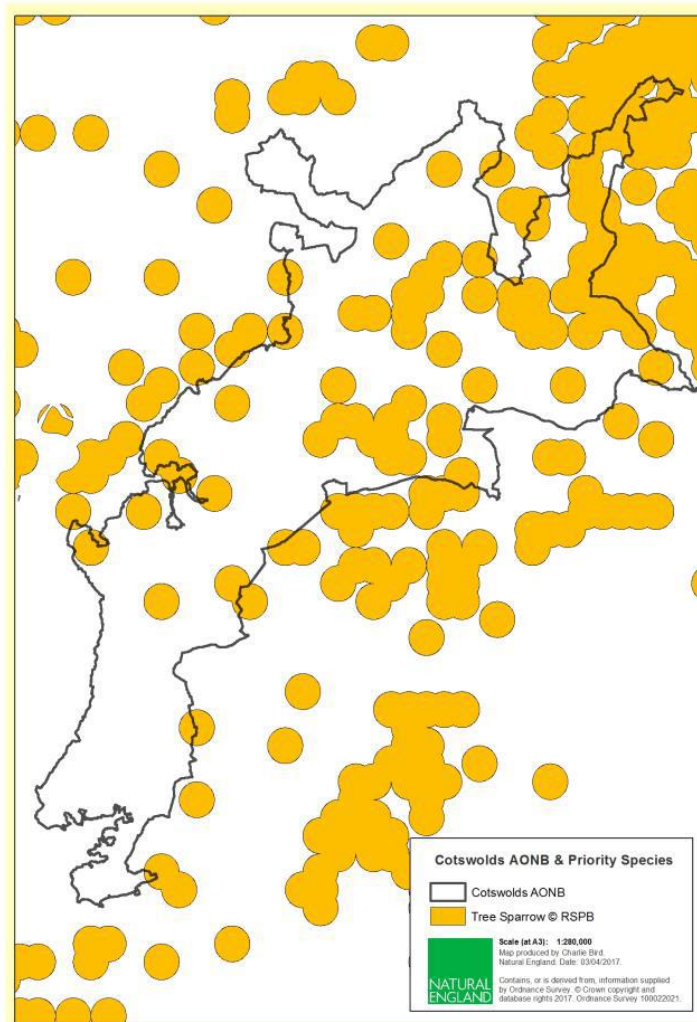
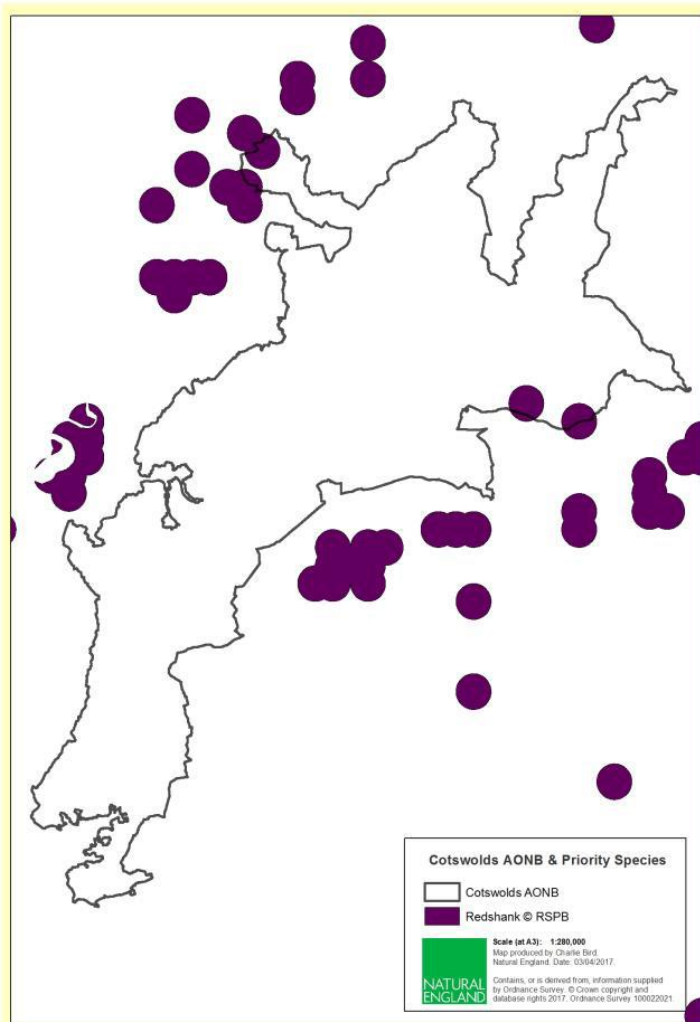
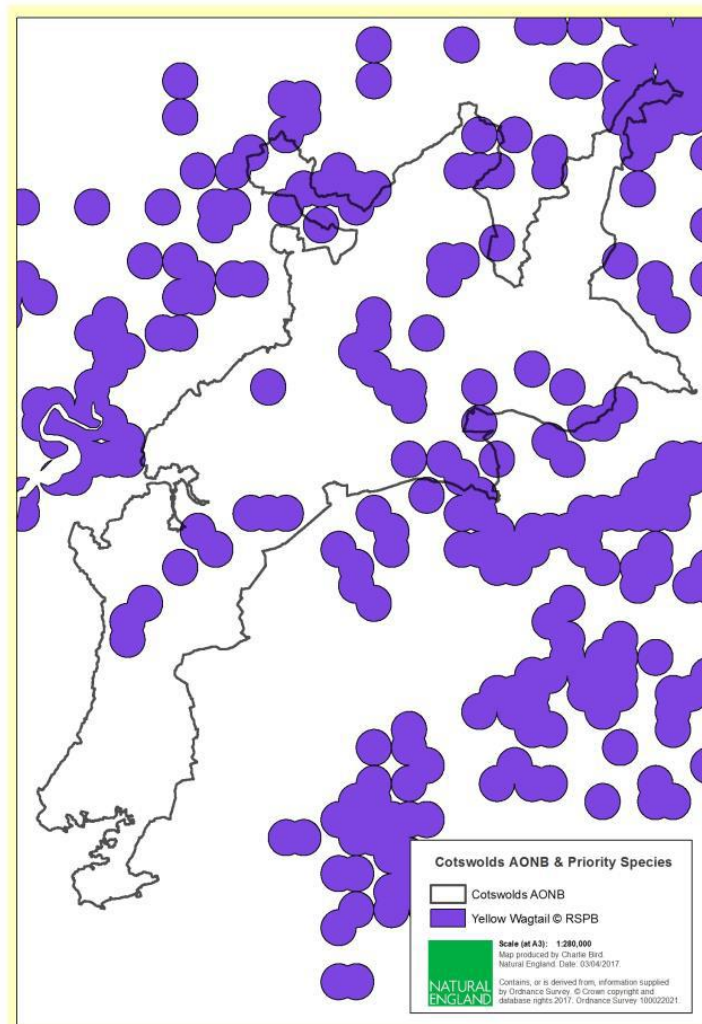
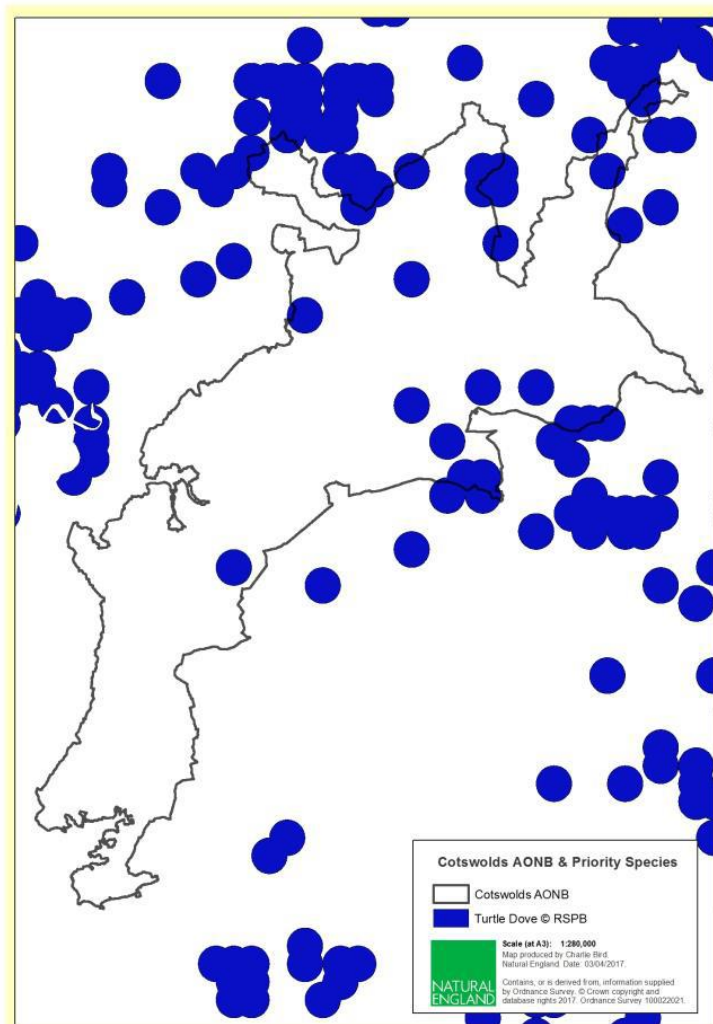


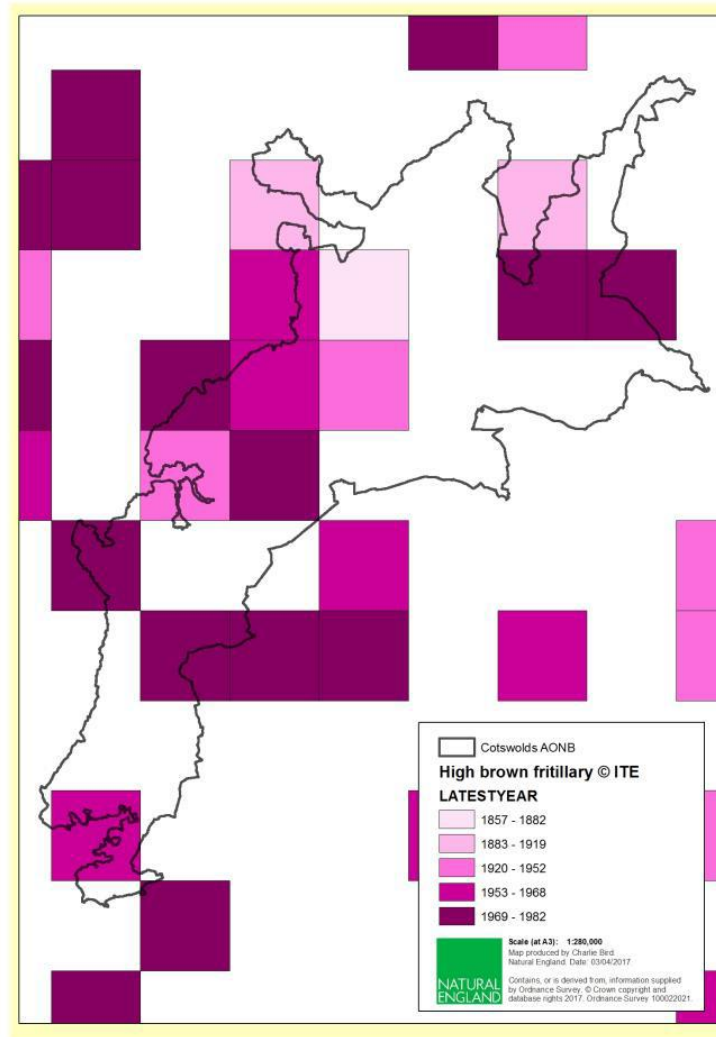
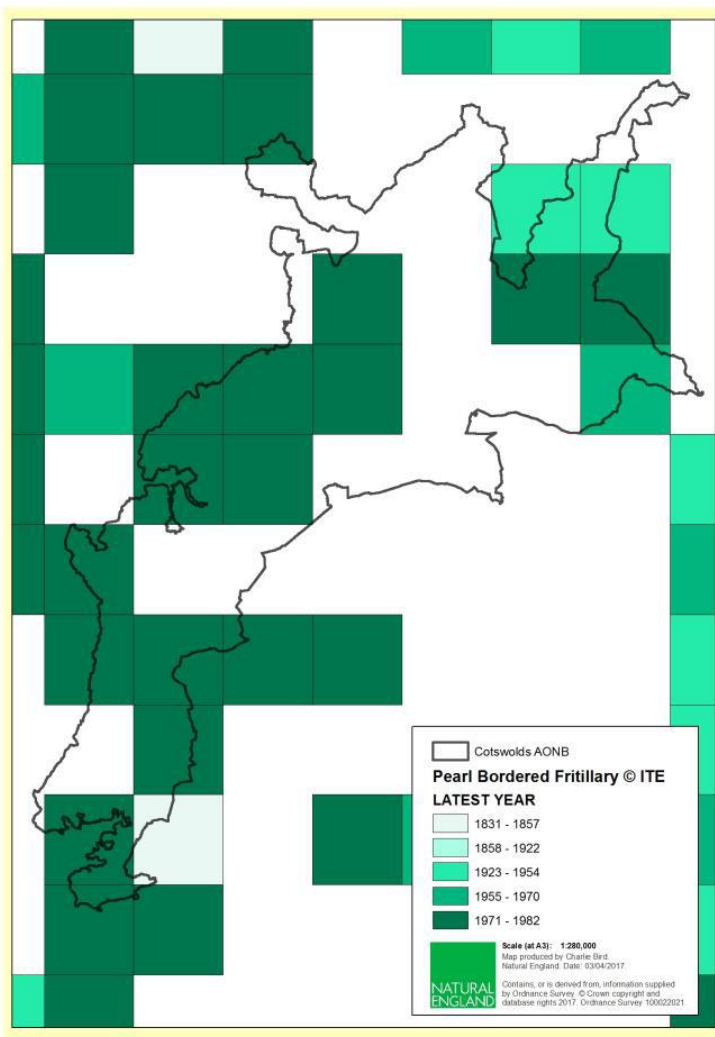
Figure 3: Priority Species in the Cotswolds AONB – Distribution Maps

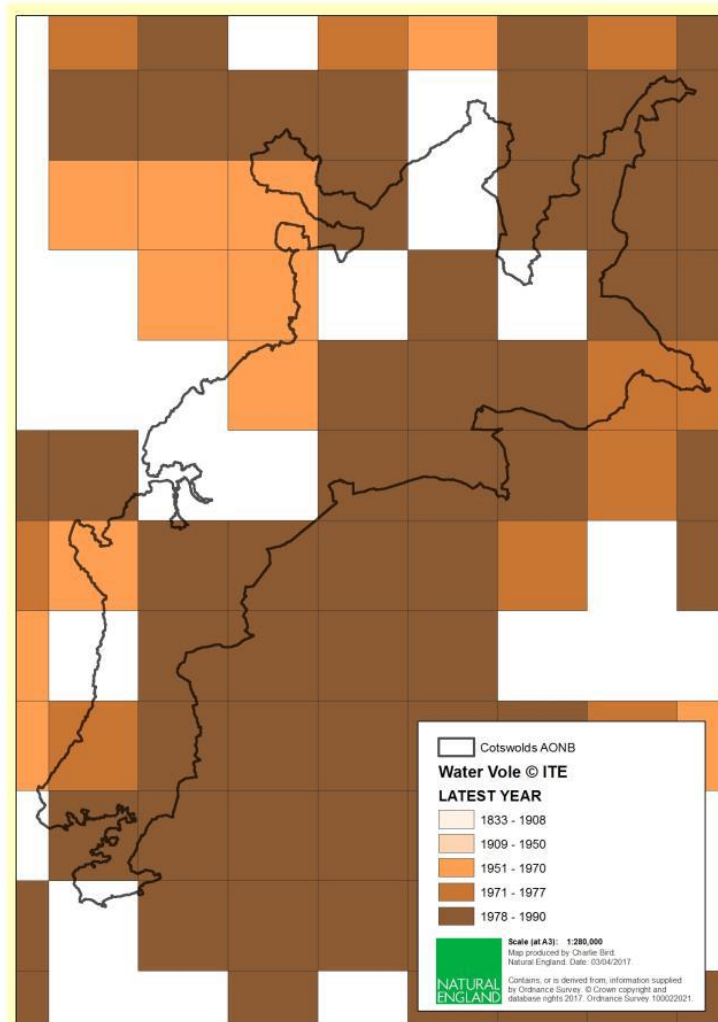
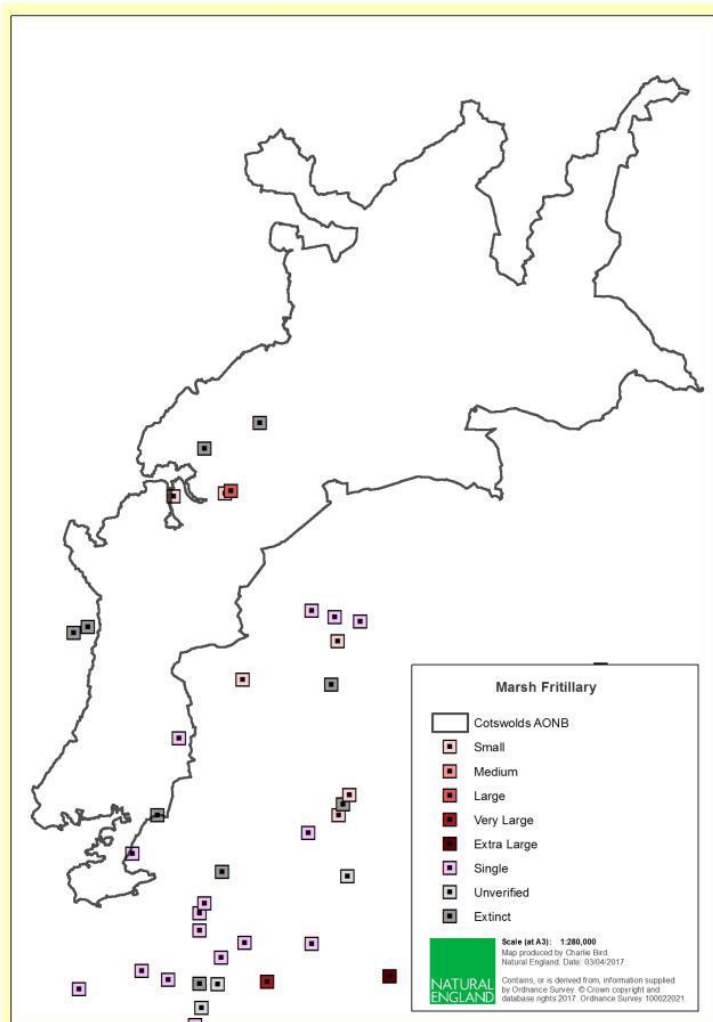


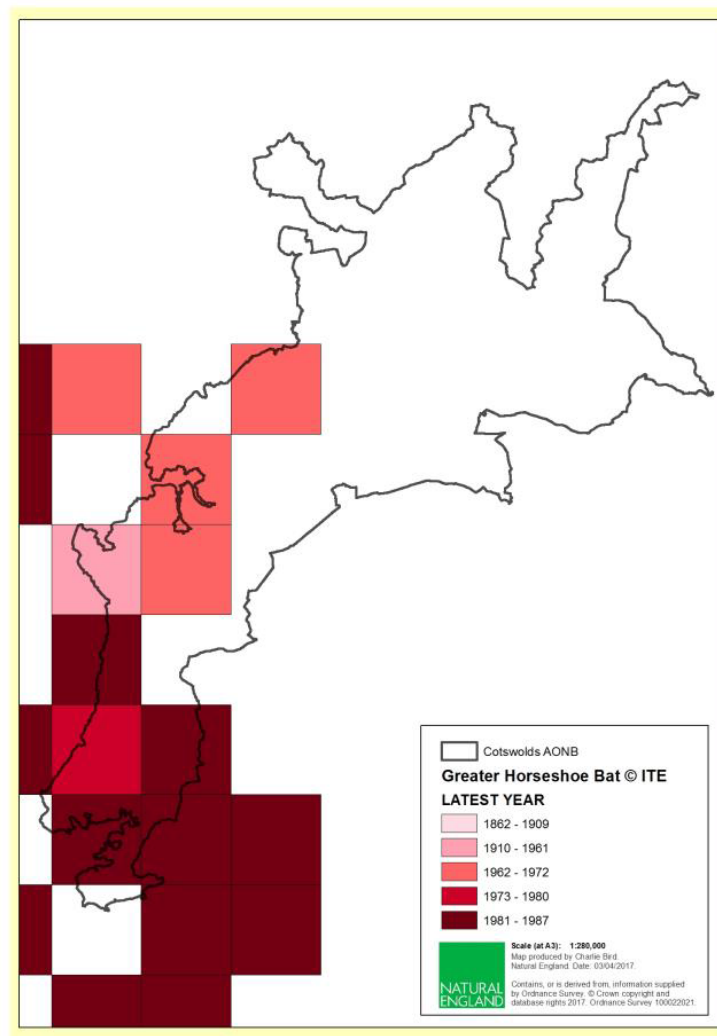
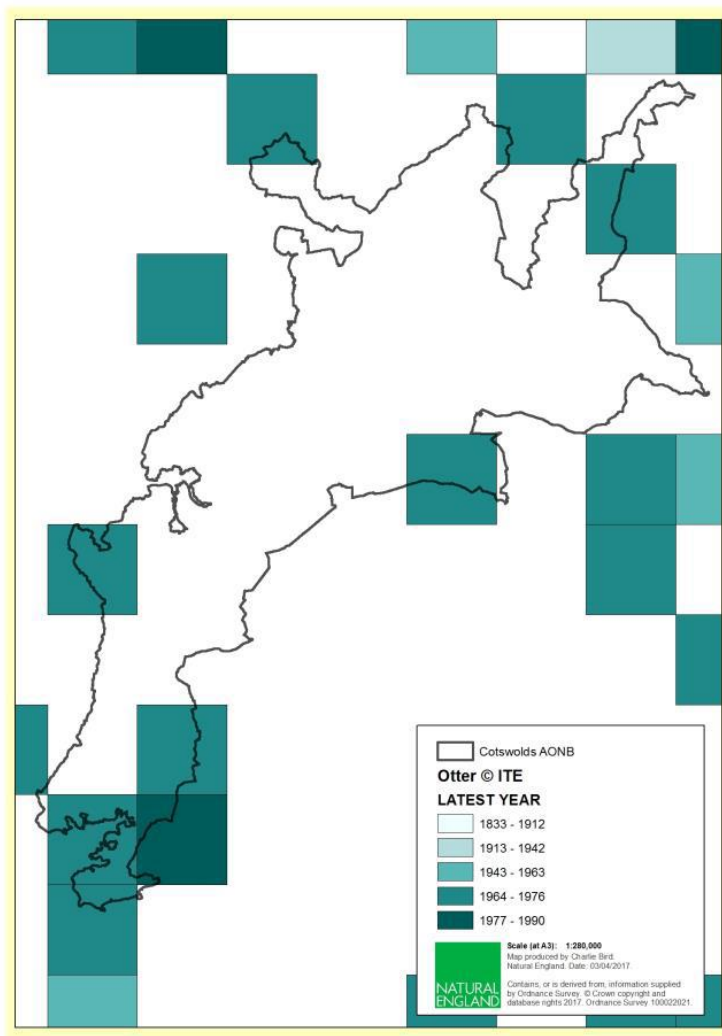


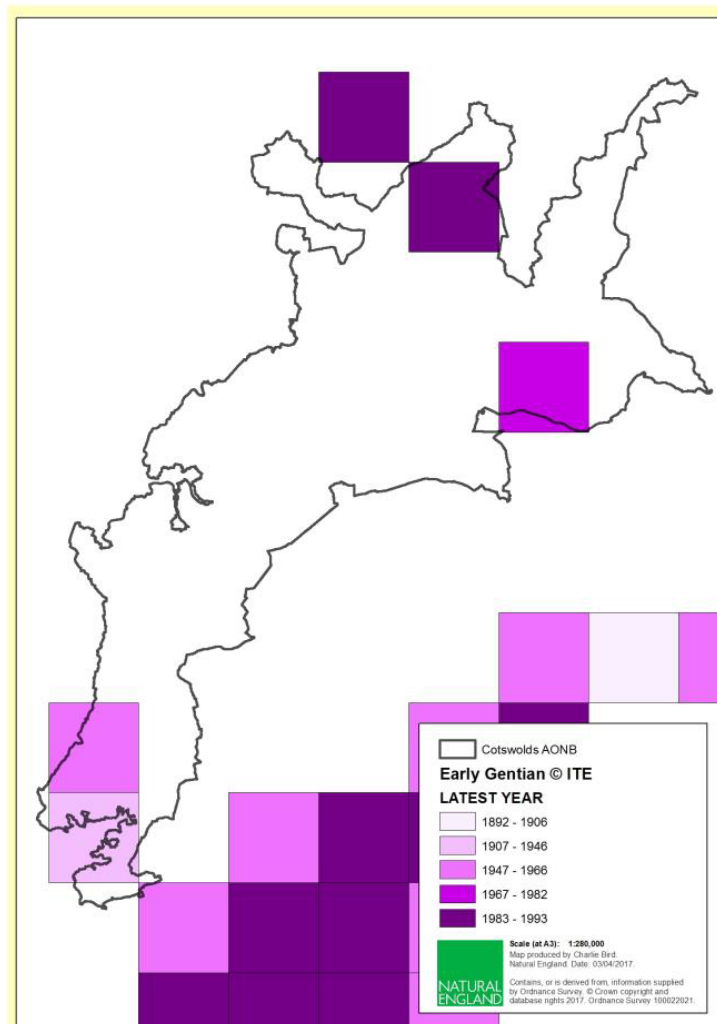
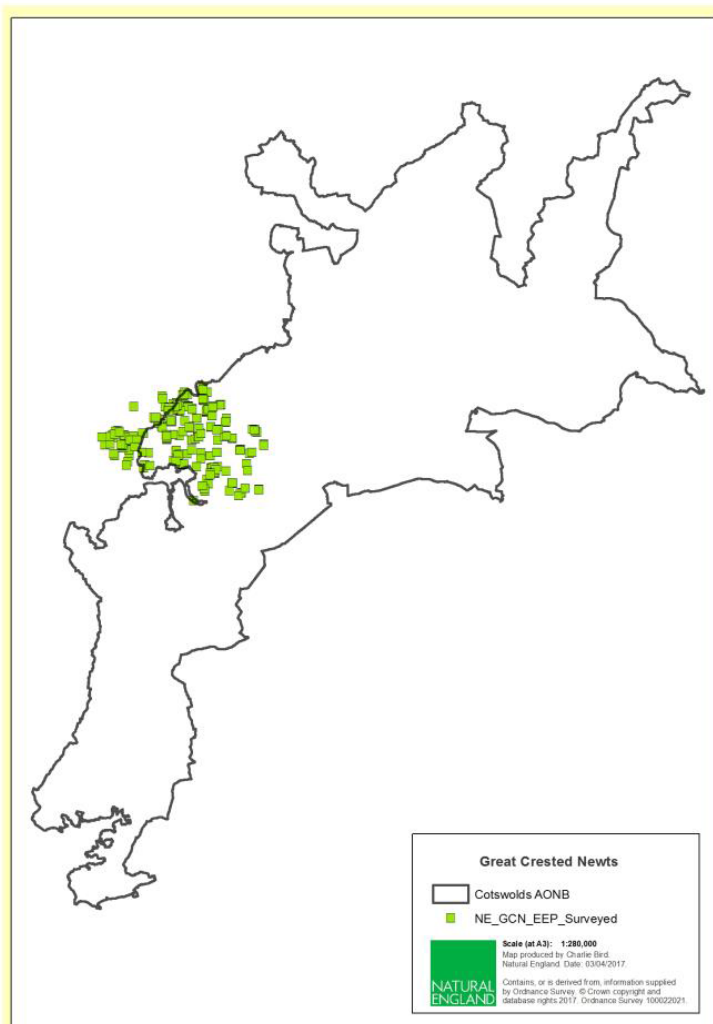












References

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- ¹ http://www.cotswoldsaonb.org.uk/userfiles/file/visitor%20centre/geology-history-landscape_1000-1800_%20.pdf
- ² <https://www.landis.org.uk/services/soilsguide/soilscapes.cfm?ssid=3>
- ³ <https://www.landis.org.uk/services/soilsguide/mapunit.cfm?mu=34304>
- ⁴ <https://www.landis.org.uk/services/soilsguide/soilscapes.cfm?ssid=9>
- ⁵ <http://www.cotswoldsaonb.org.uk/userfiles/file/Factsheet/FACTSHEET7.pdf>
- ⁶ <http://apps.environment-agency.gov.uk/wiyby/117020.aspx>
- ⁷ http://www.cotswoldsaonb.org.uk/userfiles/file/meetings-2013/c_and_m_meetings/agenda_item_10_-thames-water-business-plan-consultation-v2.pdf
- ⁸ <http://www.bgs.ac.uk/research/groundwater/shaleGas/aquifersAndShales/maps/aquifers/CorallianLimestone.html>
- ⁹ Estimate by Mark Connelly, Cotswolds Conservation Board in 2016
- ¹⁰ Allen, D J, Brewerton, L J, Coleby, L M, Gibbs, B R, Lewis, M A, MacDonald, A M, Wagstaff, S J, and Williams, A T. 1997. The physical properties of major aquifers in England and Wales. British Geological Survey Technical Report WD/97/34. 312pp. Environment Agency R&D Publication 8. <http://nora.nerc.ac.uk/13137/1/WD97034.pdf>
- ¹¹ <http://apps.environment-agency.gov.uk/wiyby/37833.aspx>
- ¹² http://www.cotswoldsaonb.org.uk/userfiles/file/meetings-2013/c_and_m_meetings/agenda_item_10_-thames-water-business-plan-consultation-v2.pdf
- ¹³ Cotswolds Catchment Abstraction Licensing Strategy December 2012
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289898/LIT_3201_c09752.pdf
- ¹⁴ CCB (2017) The State of the Cotswolds 2017 Indicators of Change for the Cotswolds Area of Outstanding Natural Beauty
- ¹⁵ Environment Agency (2014) Thames Catchment Abstraction Management Strategy 2014
- ¹⁶ Updating and Screening Assessment for Cotswold District Council In fulfillment of Part IV of the Environment Act 1995 Local Air Quality Management May 2015
- ¹⁷ Cumulus Consultants (2015) Farming, forestry and the equestrian sector in the Cotswolds AONB, Update 2015. Report for the Cotswolds Conservation Board
- ¹⁸ Natural England data supplied on 25 April 2017.
- ¹⁹ RSPB data and Natural England maps supplied on 25 April 2017
- ²⁰ North Cotswold Ornithological Society <http://ncosbirds.org.uk/cotswoldbirds.html>
- ²¹ ITE/Butterfly Conservation data and Natural England maps supplied on 25 April 2017

²² <http://www.gloucestershire-butterflies.org.uk/bflyglos/habitats.html>

²³ ITE data and Natural England maps supplied on 25 April 2017