Norfolk hawker – threatened

From first life to the Industrial Revolution

The earliest life forms on Earth date back 3,600 million years. Precambrian marine sedimentary rocks in Charnwood Forest, Leicestershire and on the Long Mynd in Shropshire contain evidence of England's first native species – complex soft-bodied organisms preserved as trace fossils between 600 and 630 million years ago. England's geological record reflects continuous environmental change with extremes of climate from desert to tundra, the rise and fall of sea level, and periods of volcanic activity and mountain building. These changes have had an impact on the distribution, evolution and loss of habitats and species. The geological record provides evidence for five mass extinctions of species. The largest of these, at the boundary between the Permian and Triassic periods 251 million years ago, is estimated to have led to the loss of 96 per cent of marine species and 70 per cent of land species. This extinction is strongly linked to a prolonged period of global warming, asteroid impact and increased volcanic activity. Dinosaurs died out during perhaps the best-known mass extinction at the end of the Cretaceous (65 million years ago). This saw the loss of 75 per cent of known species, but opened a range of ecological niches that paved the way for the rise of the mammals and birds. Although widely interpreted as the consequence of a catastrophic event – there is global evidence of an asteroid impact and of widespread volcanism leading to a change in global climate – there is also clear evidence that species were already in decline.

During the Quaternary Period (the Ice Ages), spanning the last 1.8 million years, Europe

England's lost species

■ *Lycaena tityrus* (Sooty copper) c1890 ■ *Lycaena virgaureae* (Scarce copper) 1860 ■ *Nymphalis polychloros* (Large tortoiseshell) c1953 ■ *Parnassius Apollo* (Apollo) c1850 ■ *Plebicula dorylas* (Turquoise blue) c1915 ■ *Pontia daplidice* (Bath white) 1900 ■ *Pyrgus armoricanus* (Oberthur's grizzled skipper) c1860

experienced extreme climate change. Ice sheets repeatedly advanced and retreated across much of England. At times of maximum glacial advance, sea levels were up to 120 metres lower than at present and animals such as woolly mammoths, woolly rhinoceros and reindeer roamed southern England. When the ice retreated, England's climate warmed and animals more typical of modern Africa including elephants, hippopotamus, hyena and lions dominated the land. Today they can be found as fossils in Quaternary river and cave sediments. These also provide the first evidence of a human presence in Britain. Worked flint artefacts, dating from about 650,000 years ago have been unearthed in Suffolk, and human remains dating from 500,000 years ago have been discovered in Sussex. These were early ancestors of modern humans who arrived in the last 20-30,000 years.

The archaeological and pollen records contain abundant evidence of climate change and of the impact of man's activities on the vegetation, fauna and landscape of England. After the last glacial period, around 10,000 BC, England was colonised by plants and animals moving northwards across Europe as the climate warmed, including some which have subsequently been lost. This life took the form of an extensive temperate forest or 'wildwood'. The woodland fauna included large herbivores such as red deer, aurochs (wild cattle), wild boar and predators such as wolf, lynx and brown bear. Between 10,000 and 4,000 BC, human influence over most of the country was probably no greater than most of the natural events of the time. Hunters may have used fire to alter the vegetation, but this would only have affected the grazing available for wild animals within the vicinity of the settlements scattered across the countryside.

Human intervention began to have a significant impact during the Neolithic period, which began around 4,000 BC, notably when farming was introduced from the European mainland. Neolithic clearances by tree-felling and livestock grazing transformed vast expanses of forest, replacing the natural vegetation with a much finer-grained mosaic of habitats, many of which were open in character. By the late Bronze Age (around 1,000 BC) it is likely that at least half of the wildwood had been cleared or converted to wood pasture and coppiced woodland. Arable crops had been introduced, along with their weeds and associated insects, and new opportunities had been provided for some native species to expand from their specialised niches. During the Iron Age and Roman periods (700 BC – 410 AD), the human population and its demand for wood increased substantially. New habitats were created as forests were destroyed and new insect species, such as grain weevils, which lived in granaries in towns, docks and forts, entered the record.

The last 200 years

In the period since the start of the Industrial Revolution, many forms of long-practised management have ceased, and the habitats they produced have been lost. For example, commercial coppice management of woodlands, carried out for millennia, largely ended in the early 20th century. Other forms of management, notably arable farming, have become too intensive and regionally-specialised to support a diversity of wildlife. Many habitats have been lost or have become fragmented as farmed and urban land has expanded in area, and they have lost much of their special wildlife as a consequence. Some species, among them the wolf, bear and red kite, were persecuted to extinction while others, like the wild boar, succumbed to woodland habitat loss and over-hunting by a burgeoning human population. This document details these losses.

Today, there is much debate as to whether we are facing a sixth period of global mass species extinction. This one would be man-made, resulting from the intensification of agriculture, increasing levels of human settlement and industrial pollution, and the accumulation of greenhouse gases.

England's lost species

Caddisflies ■ *Hydropsyche exocellata* 1902 ■ *Orthotrichia tragetti* 1915 ■ *Oxyethira distinctella* 1919 **Cnidarians** ■ *Edwardsia ivelli* (Ivell's sea anemone) 1983 **Dragonflies** ■ *Coenagrion armatum* (Norfolk damselfly) 1958 ■ *Coenagrion scitulum* (Dainty damselfly) 1953 ■ *Oxygastra curtisii* (Orange-spotted emerald) 1963

Definitions used in this report

Native: any species whose presence in England is not a direct result of an accidental or deliberate introduction by man.

Non-native: any species whose presence in England is a direct result of an accidental or deliberate introduction by man.

Extinct: species that have been lost from England.

Globally extinct: species that have been lost from the Earth.

Locally extinct: species that have been lost from part of England.

Extant: species that still occur in England.

To ensure consistency of treatment between taxonomic groups, our focus is on the species native to England, so we have excluded lower taxonomic divisions (eg sub-species, micro-species) and some very long-established non-natives such as the rabbit, hare and a significant number of vascular plants. Determining which species are native often requires painstaking work. There are similar difficulties in establishing just when a species has become extinct. Whilst it is often a relatively straightforward task for a conspicuous species such as the wolf or white-tailed eagle, it is less easy for small and poorly-studied species such as the algae. Particular difficulties in assessing decline and extinction also arise with migratory species such as bats, cetaceans, birds and some insects, which may occur long after a regular breeding population in England has been lost.

At a global scale, the International Union for the Conservation of Nature (IUCN) considers a lack of records for a 60-year period sufficient to declare a species extinct. However, even after such a period, species do re-emerge. In England, we have witnessed the return of the chough in 2001 after an absence of 54 years; we rediscovered the ghost orchid, moon carrot rust and great pignut rust in 2009 after absences of 23, 63 and 73 years respectively; and at least 30 invertebrates feared extinct in England have been re-found since the late 1980s. Other species have certainly been lost but then re-colonised naturally, such as the polecat, while others, such as the large blue butterfly and the red kite, have been deliberately re-introduced. Any re-colonists and species whose re-introductions have been regarded as a success, are included as extant species in this report.

Rather than adhere to a set period of absence, we have opted to seek consensus among the specialist community about which species are extinct in England. The tendency to divide species into 'extant' and 'extinct' varies between expert groups and individual recorders. Botanists, for example, tend not to treat a species as extinct if it has been recorded within the previous decade. In contrast, because birds may continue to appear as non-breeding visitors, ornithologists tend to recognise species as occasional breeders for a considerable period before treating them as extinct. Others prefer to use terms such as 'presumed extinct' and some just refer to the date last recorded. Whilst the detail does matter, the overall message about loss is unaffected. Indeed, a natural tendency to caution among animal and plant specialists in such matters will almost certainly mean that some recently-lost species which may have been given the benefit of doubt, will, in fact, be extinct.

Our area of interest is England, whose land area is divided into nine Government regions (South East and London are sometimes combined). It includes the UK waters that occur around England, which we refer to as the English seas.

England's lost species

Earwigs ■ *Labidura riparia* (Tawny earwig) c1930 **Ferns** ■ *Asplenium fontanum* (Rock spleenwort) ■ *Cystopteris alpine* (Alpine bladder-fern) 1911 ■ *Cystopteris Montana* (Mountain bladder-fern) 1880 **Fish** ■ *Coregonus oxyrinchus* (Houting) ■ *Lota lota* (Burbot) mid-1900s **Fleas** ■ *Megabothris rectangulatus* (Vole flea) 1912

Large copper – extinct

Scale of loss to the present day

We have collated all available data on the species known to have been lost from England since the first century AD*. For some taxa, including certain poorly studied invertebrate groups, freshwater algae and fungi, the total number of species in England is unknown. Hence it is impossible to say exactly what proportion has been lost.

We estimate that at least 55,500 species are native to England. We know that at least 492 of these have been lost since the first century AD. Overall, the scale of loss, at less than 1 per cent of total native species, is small. However, the proportion of native species now lost from the better-studied groups varies from zero to almost a quarter of known species (Table 2).

* With the exclusion of some beetles known only from Saxon and Roman deposits.

England's lost species

Flies ■ *Aenigmatias brevifrons* 1913 ■ *Belida angelicae* 1936 ■ *Centrophlebomyia furcata* 1906 ■ *Ceromya monstrosicornis* 1940 ■ *Chrysoscosmius auratus* 1943 ■ *Clitellaria ephippium* 1850 ■ *Crossopalpus setiger* 1912 ■ *Dasypogon diadema* 1947 ■ *Diaphorus winthemi* 1946 ■ *Dolichopus melanopus* 1872 ■ *Entomophaga exoleta* 1949

Table 2 Loss of native species from England, ordered by percentage loss

Species group	Number of surviving native species	Number of native species lost	Percentage of native species lost
Butterflies	57	18	24
Amphibians	7	2	22
Mammals – regularly occurring whales and dolphins	11	2	15
Algae – stoneworts	25	4	14
Mammals – terrestrial (including seals)	43	6	12
Stoneflies	30	4	12
Bees	246	23	9
Dragonflies	37	3	8
Birds – regular breeding species	175	10	5
Freshwater fish	35	2	5
Wasps	224	12	5
Mosses	647	32	5
Mayflies	50	2	4
Moths	2441*	89	4
Lichens	1388	50	4
Caddisflies	193	3	2
Ants	49	1	2
Vascular plants	1287	20	2
Liverworts	248	4	2
Water beetles	386	6	1
Spiders	636	4	1
Bugs – heteropterans	553	7	1
Algae – marine	520	1	<1
Fungi	>12,000	59	<1
Other terrestrial and freshwater invertebrates	33,014*	>128**	<0.5
Reptiles	7	0	0
Marine fish	275	0	0
Hoverflies	264	0	0
Grasshoppers and crickets	28	0	0
Hornworts	4	0	0

* As we do not have comprehensive England-specific data on a) moths and b) other terrestrial and freshwater invertebrates, we have assumed that the ratio of England to UK species is the same as in the 13 invertebrate groups for which we have more detailed information and which are listed in the table (an unweighted mean of 96.1% of UK species are found in England).
** Includes Ivell's sea-anemone, a brackish-marine species.

England's lost species

■ *Eudorylas dissimilis* 1965 ■ *Eudorylas restrictus* 1901 ■ *Eudorylas ruralis* 1901 ■ *Eurysthaea scutellaris* 1902 ■ *Gasterophilus haemorrhoidalis* 1917 ■ *Hemerodromia melangyna* 1913 ■ *Hilara aeronetha* 1930-33 ■ *Huebneria affinis* 1921 ■ *Hypoderma bovis* 2000 ■ *Hypoderma lineatum* 2000 ■ *Lispe hydromyzina* ■ *Macrocera inverse* 1923

Extinct in England: examples of native species that have been lost


1
Spotted sulphur, lost 1960


2
Burbot, lost 1960


3
Ivell's sea anemone, lost 1983


4
Irish lady's-tresses, lost 1990s


5
Black backed meadow ant, lost 1988


6
Lynx, lost first century


7
Red backed shrike, lost 1988


8
Large tortoiseshell, lost 1953

England's lost species

■ *Macrocera propleuralis* 1938 ■ *Ochlerotatus communis* 1922 ■ *Ochlerotatus leucomelas* 1919 ■ *Ochlerotatus sticticus* 1938 ■ *Ochthera schembrii* 1908 ■ *Palaeodocosia alpicola* 1923 ■ *Peleteria rubescens* 1931 ■ *Phaonia gracilis* 1943 ■ *Phaonia scutellata* 1898 ■ *Phebellia stulta* 1929 ■ *Phora speighti* 1918 ■ *Phthiridium biarticulatum* c1966

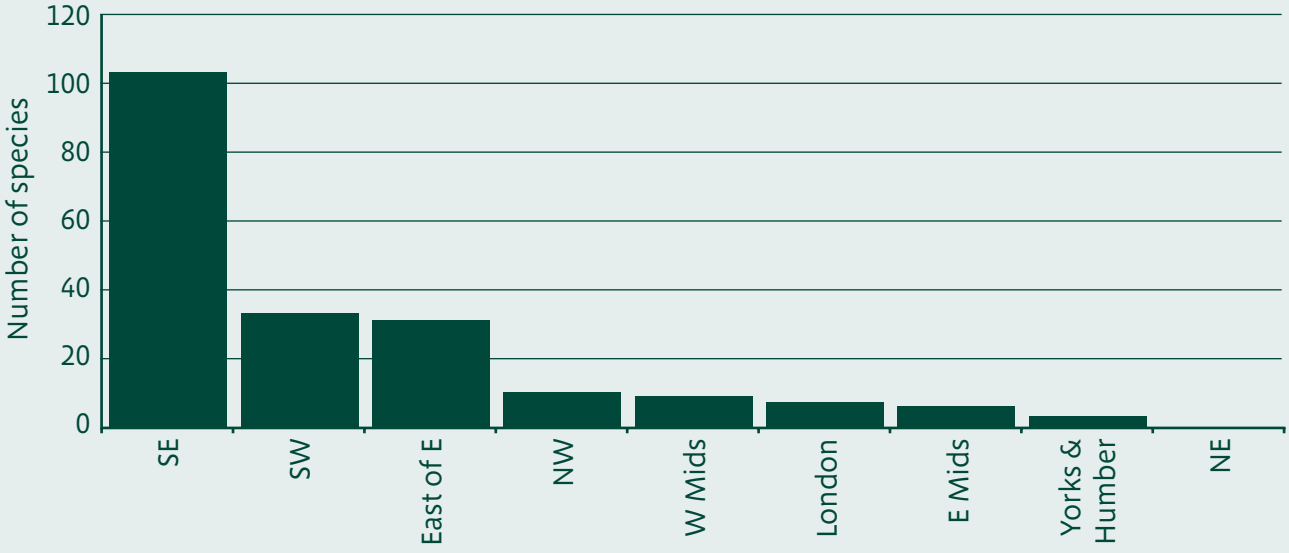
Species have been lost from most of the major groups of flora and fauna, with butterflies, amphibians, land and marine mammals, stoneflies and stoneworts suffering the greatest proportion of loss. Only the grey whale, beaver, lynx, wolf, brown bear, ptarmigan, capercaillie, white-tailed eagle, moor frog, agile frog and two mining bees are known to have been lost between the first century AD (our early date cut-off) and 1800. The agents of loss are not precisely known but, typically, habitat loss and damage and hunting have been the principal causes.

Patterns of loss in invertebrates

Invertebrates form the bulk of species lost, and the greatest invertebrate loss has been in South East England (Figure 1). Losses have also been significant in the South West (mainly from Dorset) and the East of England region (primarily from Fenland and Broadland). There are two main reasons why the greatest losses have been recorded in the South East. Firstly, more invertebrate species occur in the South East because of its proximity to the rich invertebrate fauna of continental Europe; it is warmer and drier than many other parts of the country; and it has a high incidence of soft geology and a good range of protected woodlands and parklands. Secondly, invertebrates have been well recorded in this area since Victorian times, so the probability of detecting loss is much greater than in other regions.

The number of invertebrate species lost from the South East per decade rose steadily from 1800 to a peak in the first decade of the 20th century (Figure 2). The rate of loss subsequently fell, markedly so since the 1970s. The apparent reduced rate of loss since the 1970s may well be to do with the increase in entomological recording effort and a reluctance to declare species as lost until they have been unrecorded for some time.

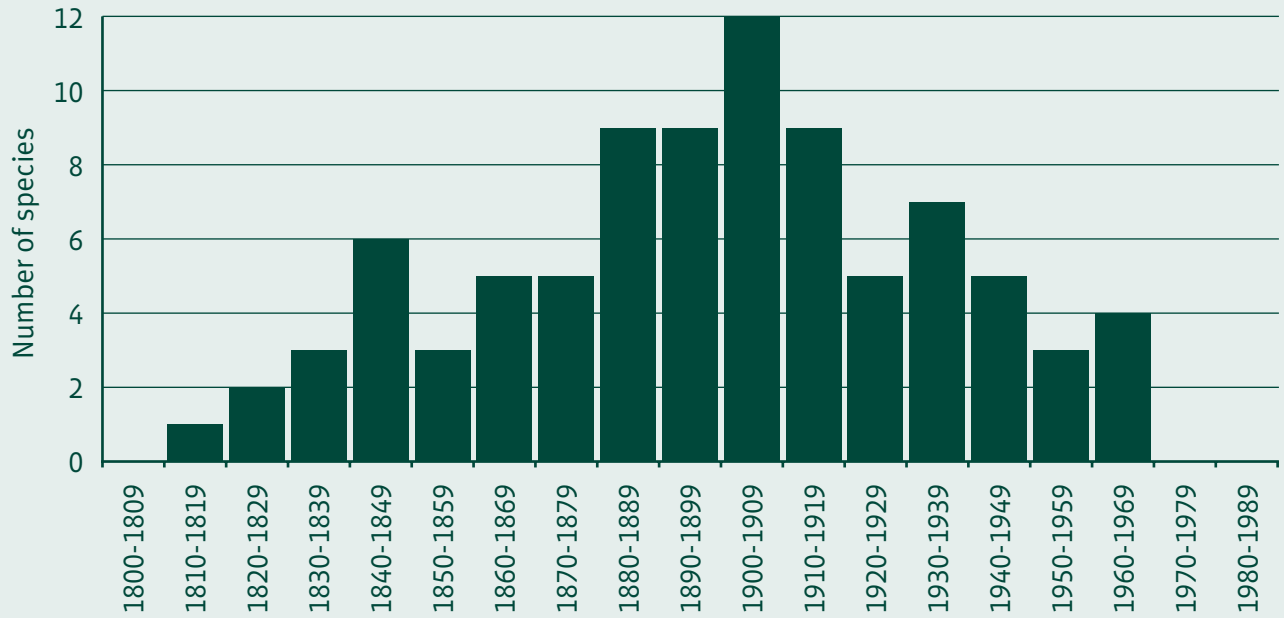
Figure 1 Last records of now extinct invertebrate species by English region, 1800-1996



England's lost species

■ *Platypalpus ochrocera* 1911 ■ *Poecilobothrus majesticus* 1907 ■ *Rhaphium pectinatum* 1868 ■ *Scatella fusca* 1886 ■ *Sciophila cliftoni* 1800s ■ *Solva varium* 1830 ■ *Tachydromia halterata* 1937 ■ *Triphleba smithi* 1934 **Frogs** ■ *Rana dalmatina* (Agile frog) ■ *Rana arvalis* (Moor frog) **Fungi** ■ *Bauhinus marginalis* 1921

Figure 2 Last records of extinct invertebrates in the South East, 1800 to 1989



Patterns of loss in plants

The pattern of loss among plants has been studied in some detail. For example, 103 plant species are known to have been lost since 1700 from Northamptonshire, a relatively rural and geologically uniform county with few of the scarce habitat specialists found in adjacent counties (Figure 3). The species lost represent 13 per cent of the county's 810 known native plant species. While they have taken place over almost 300 years, the bulk of losses (74) have occurred in the 20th century, at an average rate of 0.82 species per year. The losses from English counties generally vary from 0.84 species per year in Middlesex to 0.25 in Northumberland (Figure 4). Rates of loss in southern and eastern counties are generally greater than those in western and northern counties, mirroring the pattern found in invertebrates. Average 20th century plant loss from the 23 English counties included in the study is 0.51 species – that's more than one species every two years since 1900. The highest rates of loss have occurred since the 1960s.

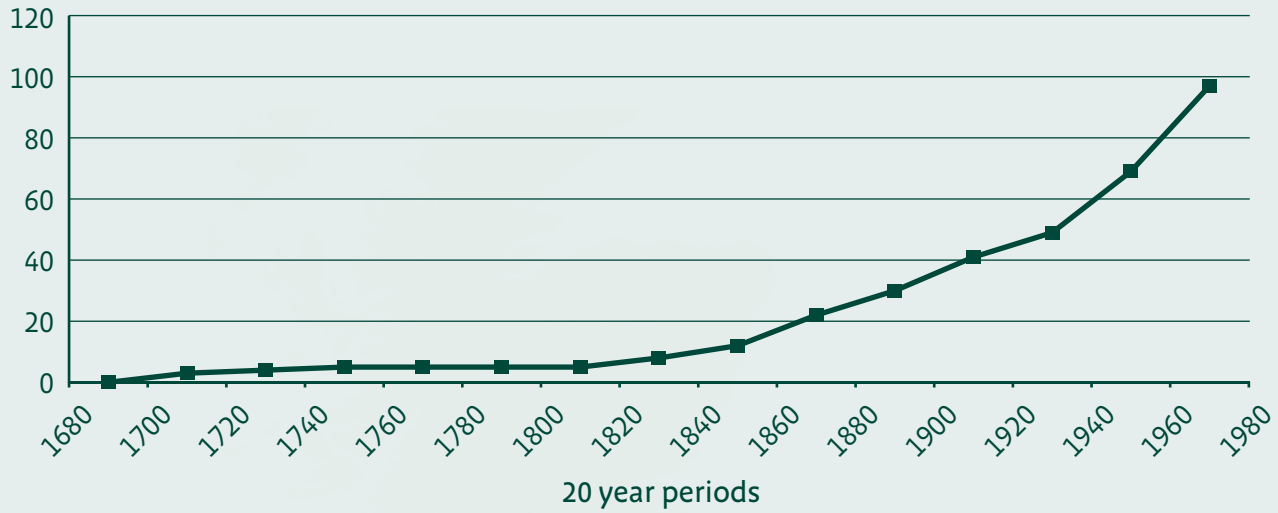
Predictors of plant species loss

The most important predictors of which plant species will be lost from lowland counties appear to be rarity, their degree of habitat specialisation and competitive ability. Low-growing species of open, nutrient-poor habitats decline most as tall, nutrient-demanding species increase, especially in arable and neutral/acid grasslands. Overall, habitat loss and eutrophication have been the primary drivers of localised plant loss in lowland regions over the past 350 years. A lack of management is also a major threat to habitat specialists, which tend to be isolated in otherwise intensively managed lowland farmland landscapes.

England's lost species

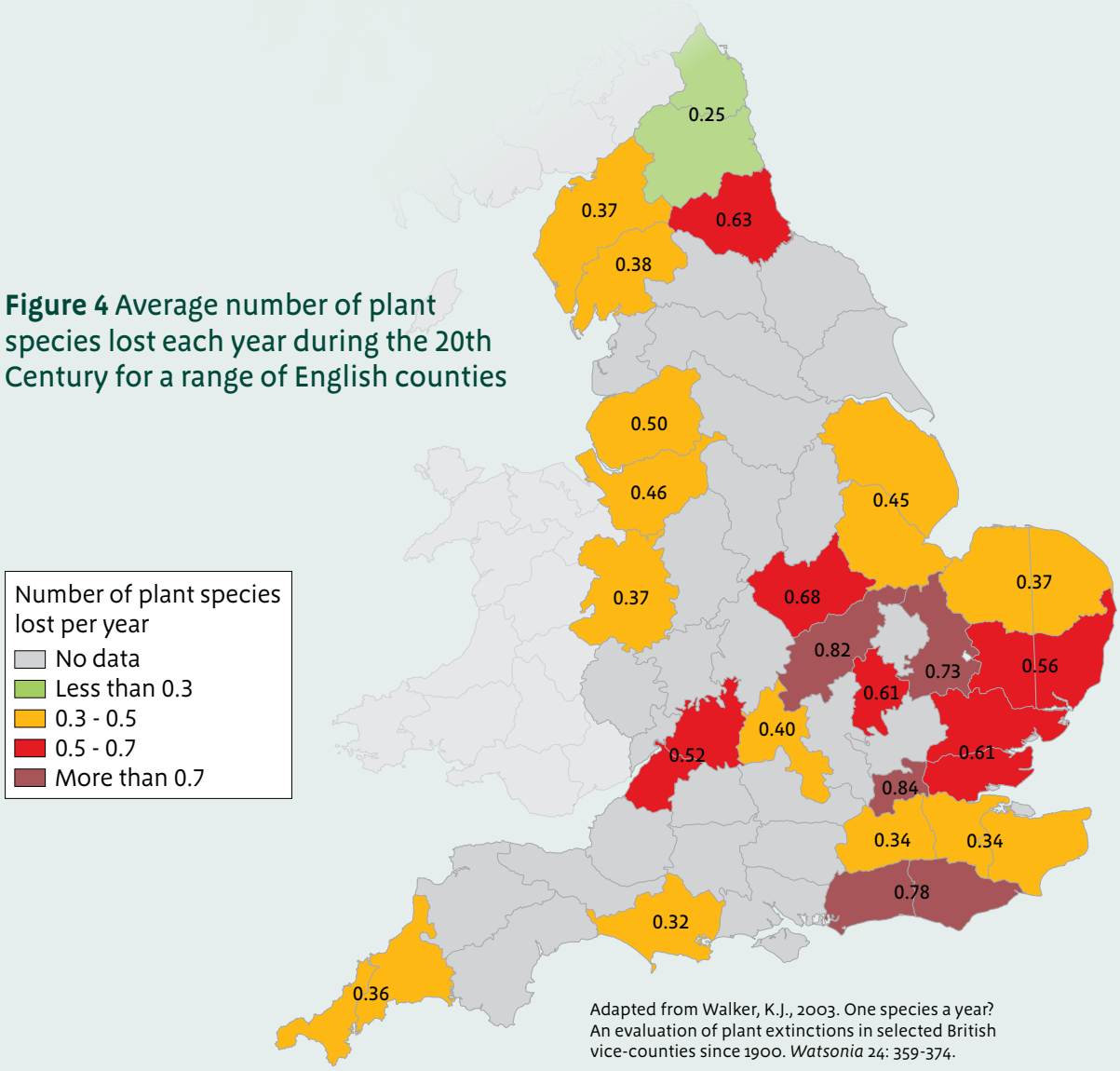
■ *Bauhinus pustulatus* 1924 ■ *Bovistella radicata* (Rooting puffball) 1952 ■ *Clavariadelphus ligula* 1953
■ *Clavariadelphus truncatus* 1924 ■ *Clavicorona pyxidata* (Candelabra coral) 1920 ■ *Cortinarius cumatilis* 1868
■ *Doassansia limosellae* 1929 ■ *Geoglossum peckianum* 1910 ■ *Gomphus clavatus* (Pig's ear) 1927

Figure 3 Cumulative number of plants lost per decade from Northamptonshire



Adapted and updated from Walker, K.J., 2009. Ecological Changes in the British Flora. PhD thesis, University of Durham.

Figure 4 Average number of plant species lost each year during the 20th Century for a range of English counties



Adapted from Walker, K.J., 2003. One species a year? An evaluation of plant extinctions in selected British vice-counties since 1900. *Watsonia* 24: 359-374.

England's lost species

■ *Gyromitra ambigua* 1907 ■ *Gyromitra gigas* 1916 ■ *Haradaea duriaeana* 1902 ■ *Hygrophorus erubescens* (Blotched woodwax) 1877 ■ *Hygrophorus russula* (Pinkmottle woodwax) 1903 ■ *Irpicodon pendulus* 1831 ■ *Jamesdicksonia irregularis* 1959 ■ *Leptoporus mollis* 1957 ■ *Lycoperdon decipiens* (Steppe puffball) 1923

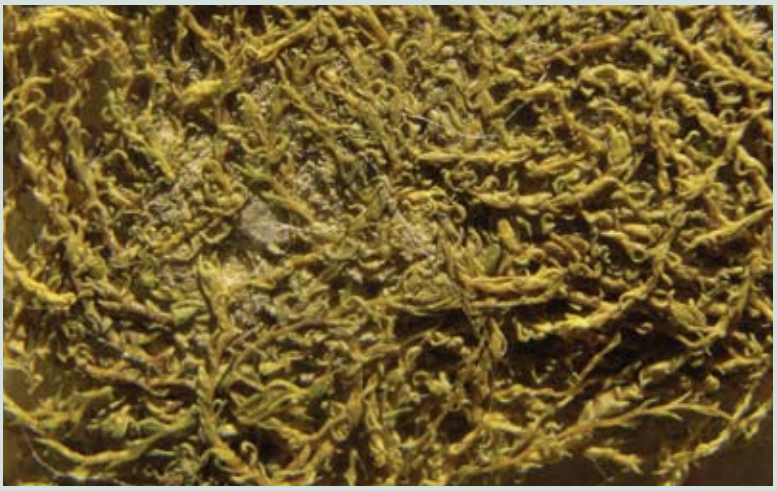
Great auk – the lost 'penguin' of the North Atlantic

The great auk was a large, flightless seabird which bred in large numbers on islands across the North Atlantic. By the 18th century it had become confined by relentless persecution (by sailors for food, feathers and fuel oil) to the most remote islands, notably off Iceland and, especially, Funk Island off Newfoundland. Great auks may well have bred in the British Isles. Evidence that the bird occurred in England comes from remains found in a cave in County Durham in 1878; a report of a bird caught on the Farne Islands in the mid-18th century; and eye-witness reports of breeding activity on Lundy until the 1820s. The last known birds were killed on Elday, Iceland in June 1844.

Great auk – globally extinct

Mitten's beardless moss – globally extinct

Mitten's beardless moss was a small moss apparently endemic to England, and known from just six sites in Sussex and Surrey. First described in 1851, it was last recorded in 1920 and would appear to have been an early casualty of agricultural improvement and changes in land use practice. Characteristic of the early stages of habitat development, it grew on soils in a variety of habitats: woodland rides, roadside banks and in fallow fields. Many similar species of arable and woodland ride habitats have declined markedly as a consequence of changes in land use and management. Intensive agriculture is too fast-paced for slower growing species to complete their life cycles. Woodland rides have either been less intensively managed and become overgrown, or have been resurfaced for recreational use, to the detriment of the flora.



Mitten's beardless moss – globally extinct. Herbarium specimen collected in 1902.

England's lost species

■ *Lycoperdon ericaeum* (Heath puffball) 1883 ■ *Mycocalia duriaeana* (Dune cannon) 1953 ■ *Panellus ringens* 1887 ■ *Perenniporia medulla-panis* 1854 ■ *Phragmidium acuminatum* 1879 ■ *Pithya vulgaris* 1888 ■ *Plicariella radula* 1853 ■ *Polystigma fulvum* 1893 ■ *Poronia erici* 1933 ■ *Pterula debilis* 1946 ■ *Puccinia albulensis* 1936

The northern right whale – loss of a giant

A total of 26 cetacean species has been recorded in English waters. These include individual specimens of the largest living animal on Earth, the blue whale, although the last record was of one stranded at Boscombe, Hampshire in January 1897. Half of these species occur or once occurred with regularity, while the remainder have probably always been casual visitors or vagrants.

Man has exploited whales since at least the Neolithic period and this is likely to have been a significant influence on cetacean population size and range since at least the 11th century. The scale of whaling in waters near to England has at times been considerable, with clear consequences for the abundance of whales in our own waters.

The North Atlantic population of blue whales, for example, was reduced by 98 per cent from an estimated 20,100 mature individuals in the 1920s to around 300 by 1980. Regular hunting of fin whales saw at least 75,000 animals taken from the North Atlantic since the late 19th century: Scottish catches alone amounted to 4,536 (Shetland) and 1,492 (Outer Hebrides) individual fin whales taken between 1903 and 1928. Irish catches totalled 435 individuals during 1908-14. Fin-whaling continued in Spanish waters until the 1980s and will almost certainly have reduced the animals' occurrence off our south-western coasts. Two species are thought to have been lost completely from our waters, including the grey whale, which has now vanished from all parts of the North Atlantic Ocean.

Northern right whale – extinct in English seas

England's lost species

■ *Puccinia asparagi* (Asparagus rust) 1936 ■ *Puccinia bulbocastani* (Great pignut rust) 1956 ■ *Puccinia cicutae* 1958 ■ *Puccinia cladii* 1957 ■ *Puccinia libanotidis* (Mooncarrot rust) 1946 ■ *Puccinia longissima* (Crested hair-grass rust) 1953 ■ *Puccinia polemonii* (Jacob's ladder rust) 1958 ■ *Puccinia pratensis* (Meadow oat-grass rust) 1959 ■ *Puccinia ribis* 1947

The northern right whale was the primary target of Spanish, French and Basque fisheries in the Bay of Biscay, from at least the 11th until the 19th century. The species must have been close to extinction by the end of the 19th century, since only four whales were recorded as taken that century. Basque whalers were also active off southern Ireland and in the English Channel from the 14th to the 16th century and right whales were also hunted in the southern North Sea from the ninth century onwards. The last confirmed record of a live northern right whale in English waters was in the North Sea in 1872 and no individuals have been found ashore since the Natural History Museum's scheme for recording strandings started in 1913. It is estimated that the North Atlantic population now consists of as few as 300-350 individuals and these are found almost entirely off the east coast of North America. The most serious threats to northern right whales are now ship-strikes and entanglement in fishing gear. More than half of those remaining have experienced at least one ship-strike or net entanglement, and at least a third of deaths each year are directly linked to human activities.

The greater mouse-eared bat – nationally extinct for now

The greater mouse-eared bat is the largest bat recorded in Britain. Although it is widely distributed in western Europe, including the western seaboard of France and the Netherlands, it is extremely rare in England. There is a single record from Cambridge in the 1880s, but the first suggestion that the species might be resident in England came from a freshly dead specimen found at the entrance to a stone mine near Purbeck, Dorset in February 1956. This led to the discovery of a small hibernation colony of up to 12 bats in 1960, but the colony had died out by 1980, possibly because of excessive disturbance. A further colony was found in Sussex with 28 individuals, divided between two adjacent underground sites, recorded in January 1970. No summer site was ever discovered and the fate of the colony was sealed when no females returned to the main hibernation site in 1974, suggesting that some disaster befell them at their maternity site. The last male lingered on until 1990. Interestingly, a young male was found at the same site a few years later and, although the possibility remains that it was raised nearby, it is assumed to have been a vagrant.

The English Channel is no great barrier for bats, and the greater mouse-eared bat is known to make regional migratory movements in mainland Europe of up to 400 km between summer and winter sites. Further attempts at colonisation are likely to occur, particularly if the climate becomes more suitable for the species.

Greater mouse-eared bat – extinct

England's lost species

■ *Pycnoporus cinnabarinus* 1913 ■ *Sarcodon regalis* (Crowned tooth) 1969 ■ *Schizonella melanogramma* 1951
■ *Stigmatula astragali* ■ *Tricholoma aurantium* (Orange knight) 1957 ■ *Uredinopsis filicina* (Beech fern rust) 1936
■ *Uredo oncidii* 1932 ■ *Urocystis alopecuri* 1946 ■ *Urocystis avenae-elatioris* 1944 ■ *Urocystis floccosa*

Regional losses

A selection of some of the special species lost from each English region

1 North East

Bittern

Angel shark

Scotch argus butterfly

The bumblebee *Bombus humilis*

Oysterplant

Tower mustard

The moss *Seligeria diversifolia*

The stonewort *Chara aculeolata*

2 North West

White-tailed eagle

Chough

Scarce crimson and gold moth

The robberfly *Dasypogon diadema*

Burnt orchid

Slender naiad

The moss *Byrum cyclophyllum*

The liverwort *Diplophyllum taxifolium*

5 West Midlands

Twite

Marsh warbler

Chalkhill blue butterfly

The micro-moth *Lyonetia prunifoliella*

The hister beetle *Hister illigeri*

Bog orchid

Various-leaved pondweed

The moss *Gyroweissia reflexa*

6 East of England

Red squirrel

Great bustard

Burbot

Dainty damselfly

The bumblebee *Bombus cullumanus*

Marsh fritillary butterfly

Yellow centaury

The stonewort *Nitella capilaris*

England's lost species

■ *Urocystis primulicola* 1904 ■ *Uromyces colchici* 1800s ■ *Uromyces tuberculatus* 1944 ■ *Ustanciosporium gigantosporum* 1865 ■ *Ustanciosporium majus* 1939 ■ *Ustilago corcontica* 1944 ■ *Ustilago marina* (Spike rush smut) 1885 ■ *Xylaria bulbosa* 1911 ■ *Xylaria digitata* 1924 ■ *Xylaria hippotrichoides* 1875

We have seen that extreme declines have already led to the loss of some species on a national scale. However, far more species have been lost on a regional scale, as a result of historic and more recent decline. Inevitably, species will be lost from regions before they become extinct nationally. This section highlights the loss of some charismatic and some lesser-known species that have occured in each region.

3 Yorkshire and the Humber

Black tern

Stone curlew

Marsh fritillary butterfly

The weevil *Coniocleonus hollbergii*

Cowbane

Lizard orchid

The moss *Aulacomnium turgidum*

The liverwort *Scapania praetervisa*

4 East Midlands

Pool Frog

Thwaite shad

The bumblebee *Bombus humilis*

Chequered skipper butterfly

Wood white butterfly

The stonefly *Isoperla obscura*

Great sundew

Lizard orchid

7 South East and London

Greater horseshoe bat

Puffin

The bumblebee *Bombus pomorum*

Blue stag beetle

Orange-spotted emerald dragonfly

The stonewort *Chara intermedia*

Mountain everlasting

Crested cow-wheat

8 South West

Greater mouse-eared bat

Roseate tern

Gannet

Natterjack toad

Irish lady's tresses

The moss *Byrum salinum*

Tawny earwig

The stonewort *Nitella hyaline*

England's lost species

Ground beetles ■ *Acupalpus elegans* 1875 ■ *Harpalus cupreus* 1914 ■ *Lebia marginata* 1800s ■ *Lebia scapularis* 1883
Heteropteran bugs ■ *Chlorochroa juniperina* 1925 ■ *Elasmucha ferrugata* 1950 ■ *Eremocoris fenestratus* 1962
■ *Eurygaster austriaca* 1885 ■ *Hadrodemus m-flavum* 1800s ■ *Jalla dumosa* 1800s ■ *Prostemma guttula* 1890