



Lost life: England's lost and threatened species

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England's lost species

This panel lists all those species known to have been lost from England in recent history. Species are arranged alphabetically by taxonomic group, then by scientific name. The common name, where one exists, is given in brackets, followed by the date or approximate date of loss – if date is known. Dates preceded by a 'c' are approximate.

Foreword

No one knows exactly when the last Ivell's sea anemone died. Its final known site in the world was a small brackish lagoon near Chichester on the south coast of England. When the last individual at this site died, probably in the 1980s, the species was lost forever: a global extinction event, in England, on our watch.

We live in a small country blessed with a rich variety of wildlife – one in which the natural world is widely appreciated, and studied as intensely as anywhere in the world. Today this variety of life is under pressure from human activities as never before. As a result, many of our native species, from the iconic red squirrel to the much less familiar bearded stonewort, are in a fight for survival.

This report documents for the first time the nearly 500 species we've lost from England in the recent past. This figure is by no means the true total since, for many species groups like fungi, algae and the marine invertebrates, we don't know the full extent of those that exist, let alone those that have disappeared. We do know that 12% of land mammals, 22% of amphibians and 24% of our native butterflies have been lost, though fortunately most of these, unlike Ivell's sea anemone, do still occur in other countries. In addition to these losses, many more species are threatened and need our help.

2010 is designated by the United Nations as the International Year of Biodiversity. We hope that by highlighting the scale of losses and current threats to England's species, and the successful efforts to improve the fortunes of some of our threatened species, this report will stimulate even greater action to conserve our natural environment. It may be too late for Ivell's sea anemone, but let's not just be the generation who realised the scale and impact of the loss of biodiversity, let's also be the generation that did something about it.

Dr Helen Phillips
Chief Executive

England's lost species

Ants ■ *Formica pratensis* (Black-backed meadow ant) 1988 **Bees** ■ *Andrena floricola* 1939 ■ *Andrena nana* 1930 ■ *Andrena nanula* 1877 ■ *Andrena polita* 1934 ■ *Andrena tridentate* 1944 ■ *Andrena vaga* 1946 ■ *Bombus cullumanus* (Cullem's bumblebee) 1941 ■ *Bombus distinguendus* (Great yellow bumblebee) 1981



Pasque flower – threatened

Executive summary

England is rich with life. Our diverse natural heritage includes myriad animals, plants and fungi. These species provide us with food and livelihoods; they help form the distinctive English landscapes and seascapes that we love; they have inspired and delighted through generations. They are England's life.

This life is being lost. Although changes in species populations are a natural consequence

of environmental change, recent technological advances have led to humans altering species' habitats in ways and at rates that make it impossible for them to adapt. This has led to the decline and loss of many of England's native species, losses that matter both for the intrinsic value of the species themselves, and because they are associated with damage to our natural environment.

England's lost species

■ *Bombus pomorum* (Apple bumblebee) 1864 ■ *Bombus subterraneus* (Short-haired bumblebee) 1990 ■ *Chalicodoma* (*Megachile*) *ericetorum* 1844 ■ *Coelioxys afra* 1892 ■ *Dufourea halictula* 1953 ■ *Halictus maculatus* 1930 ■ *Halictus subauratus* 1850s ■ *Hoplitis leucomelana* pre 1800 ■ *Hylaeus punctulatis* 1840 ■ *Lasioglossum* leave pre 1800

In this report, we highlight the fauna and flora for which England is special, and provide the first assessment of decline and loss across all types of species in England. We also identify those species at greatest risk of being lost next from England, should current trends continue. Finally, we describe the main actions that need to be taken to halt and then reverse the decline in these species. We have timed the release of the report to coincide with the United Nation's International Year of Biodiversity 2010 to help raise awareness of England's biodiversity and the fact that species are being lost from our own shores.

England has approximately 55,500 species of animals, plants and fungi. These include five groups of species considered to be of outstanding significance in an international context: Atlantic ferns, mosses and lichens; breeding seabirds; wintering and passage waterbirds and gulls; grassland and woodland fungi; and heathland invertebrates. We also have at least 40 species endemic to England (ie they occur nowhere else on Earth) and 54 species recognised as threatened at an international level.

We have been able to document the loss of 492 species from England, the vast majority of these being lost since 1800. This is likely to be a considerable underestimate of the true number of native species lost because relatively little is known about losses (or indeed the very existence) of species in the larger groups such as the many invertebrates, lower plants and fungi. The information on losses for the better studied groups reveal:

- 24% of butterflies, 22% of amphibians, 15% of dolphins and whales, 14% of stoneworts, 12% of terrestrial mammals and 12% of stoneflies have been lost from England.

Some species that have been lost from England, such as the great auk and Ivell's sea anemone, are now globally extinct. The latter was lost from its last known site in the world, a

brackish lagoon in West Sussex, as recently as the 1980s.

The principal agents of species loss and decline have been the destruction of natural habitats or their inappropriate management, and the persecution of wildlife that was considered a nuisance, a threat to livelihood or a prize specimen. Rates of loss have varied over time and between species groups. In invertebrates the rate of loss increased steadily during the 19th century to a peak in the first decade of the 20th century and has apparently since declined.

On a regional and local scale, the loss of species has been even more significant. Red squirrels have been lost from most counties in England while the purple emperor butterfly has been lost from the West Midlands and East of England regions. Some of the best data regarding local losses are from flowering plants. An assessment of loss from 23 English counties concluded that, on average, one species of plant has been lost every two years at a county level since 1900. Rates of loss in southern and eastern counties have generally been highest.

As a result of these local and regional losses, a significant number of England's remaining species are under threat. A total of 943 English species were identified in 2008 as priorities for conservation action under the England Biodiversity Strategy and UK Biodiversity Action Plan (BAP). Further species have declined in recent historic times to precariously low ('depleted') levels. In the better known groups, the proportion of native species which appear on the BAP list or which have historically depleted populations represent:

- all of the remaining reptiles, whales and dolphins, 57% of amphibians, 43% of freshwater fish, 37% of terrestrial mammals and seals, 35% of bumblebees and 33% of butterflies.

England's lost species

■ *Megachile lapponica* 1847 ■ *Melecta luctuosa* 1912 ■ *Nomada errans* 1982 ■ *Osmia xanthomelana* 1998 ■ *Rhopites quinquespinosus* 1878 **Beetles** ■ *Aglyptinus agathidioides* 1912 ■ *Ampedus sanguineus* 1830 ■ *Anthrenus pimpinellae* 1895 ■ *Anthrenus scrophulariae* 1800s ■ *Apalus muralis* c1969 ■ *Bagous arduus* 1800s ■ *Bagous binodulus* 1861

On average, 26% of England's species are depleted or on the BAP list.

Taking account of recent declines and emerging threats, in particular climate change, we have identified 12 groups of species that are of particular concern:

- Species now severely restricted in range
- Internationally important wintering and passage waterbird populations
- Internationally important breeding seabird populations
- Species associated with coastal habitats
- Species losing their English 'climate space'
- Specialist farmland wildlife
- Long-distance migrants
- Predators exposed to illegal persecution
- Native species under pressure from invasive non-natives
- Amphibian species at risk from disease
- Marine fish at risk from overfishing
- Species exposed to nutrient enrichment.

Many of the species losses and declines that have occurred were avoidable. Whilst some of the species lost can never be brought back, there are reasons to be hopeful that we can reverse current trends in declining species. Some species that had been lost, such as the chough, have returned to England in recent years and have stayed in the much-improved habitat now available to them. We have also successfully re-introduced two species to England (red kite and large blue butterfly) and have re-introduction programmes underway for pool frog, corncrake, great bustard and interrupted brome. Targeted conservation efforts have resulted in improving fortunes for many priority species on the original BAP list: 12% were reported as increasing in England in 2008, and a further 33% had stabilised. Nevertheless, the challenge ahead of us is significant, made all the more so by climate

change, and we identify six priorities for action:

- Better protect and manage the remaining wildlife habitats
- Restore and create additional high-value wildlife habitat including through enhancements at a landscape scale
- Establish a coherent network of Marine Protected Areas
- Establish more sustainable practices for all our land and seas
- Reduce the impact of invasive non-native species
- Take further steps to reduce illegal killing and collecting of our native species.

The fate of England's species is not only in the hands of government or large landowners – we all have a role to play. Past losses and declines have been the consequence of the choices that we have made in the past. We now need to take responsibility and plan for the future. Our aim must be to restore a healthy natural environment with functioning ecological processes, in which species can thrive and reach new self-sustaining levels, for the benefit of us all. The time for action is now.

England's lost species

■ *Bagous diglyptus* 1897 ■ *Bagous petro* 1895 ■ *Bidessus minutissimus* (Minutest diving beetle) 1908 ■ *Bostrichus capucinus* 1908 ■ *Bothynoderes (Chromoderus) affinis* 1883 ■ *Cardiophorus gramineus* 1863 ■ *Cardiophorus ruficollis* 1833 ■ *Ceutorhynchus hepaticus* 1909 ■ *Ceutorhynchus syrites* 1800s ■ *Chrysomela tremula* 1958 ■ *Clytra laeviuscula* 1895



Pink sea fan – threatened

Introduction

This report is the first assessment of decline and loss among England's native species. In International Year of Biodiversity, the year by which EU governments have committed to halt biodiversity loss in Europe, it is particularly relevant to ask: Which species has England

lost? Our aims in producing this report are to raise awareness of biodiversity loss, to describe the serious consequences for biodiversity if current trends continue, and to encourage greater action by highlighting some early successes in halting and reversing decline.

England's lost species

■ *Coniroleonus hollbergi* 1815 ■ *Cryptocephalus exiguus* (Pashford pot beetle) 1986 ■ *Cryptocephalus violaceus* 1864
■ *Ebaeus pedicularius* 1800s ■ *Hister illigeri* 1800s ■ *Hister quadrinotatus* 1800s ■ *Hypera arundinis* 1800s
■ *Hypocassida subferruginea* 1800s ■ *Hypocoprus latridioides* 1902 ■ *Lamprohiza splendidula* 1884

Extinction and change in species populations are a natural, indeed inevitable, part of environmental change. But for thousands of years humans have shaped the environment, and, in doing so, we have also had a powerful influence on the distribution, abundance and survival of other species. Technological advances, particularly since the Industrial Revolution, have led to a significant increase in the rate and scale of environmental change. Many species have been unable to adapt, and it is estimated that, globally, species extinction rates have increased to over 1,000 times the natural rate. These human-induced losses matter, both for the intrinsic value of the species, and because they are associated with damage to our natural environment. Unnaturally high rates of species loss are a clear sign of the unsustainable exploitation of our natural environment.

This report describes **England's natural treasures**, the species groups for which England is important in an international context. In **From first life to the Industrial Revolution** we briefly describe the geological and historical record of the evolution and extinction of species through to the Industrial Revolution.

In **Scale of loss to the present day** we then detail the scale of the loss of species in England. We have attempted to document all the species known to have been lost from England since the first century AD, where the data are available. Because the total number of species in some less well-known groups is not known, this report although authoritative, cannot be entirely comprehensive. We have also not attempted to assess numbers of species or losses among micro-organisms or bacteria.

In **Regional losses** we highlight some of the species losses that have occurred in each region.

In **Threatened species** we have identified those species which are declining and most threatened now.

The chapter on **Our concerns for the future** identifies where we most fear future losses and declines in England.

Continued species losses at the rates we are currently seeing are not inevitable. In **Turning the tide**, we describe a number of conservation successes that demonstrate how species declines can be halted and reversed through targeted conservation action.

Finally, in **Conclusions and priorities for action** the report highlights the priorities for future action if we are to provide a better future for England's remaining species.

Throughout the report we provide case studies to illustrate the loss, threats and recovery of English species.

In raising awareness of species loss and decline through this report, we do not seek to turn the clock back to some species-rich point in the past. Rather, we wish to inform the choices that will determine which species will remain and thrive in our future.

England's lost species

■ *Leiodes triepkii nec pallens* 1933 ■ *Lepturobosca virens* 1800s ■ *Lepyrus capucinus* 1897 ■ *Lixus angustatus nec algirus* 1928
■ *Lixus paraplecticus* 1958 ■ *Lixus vilis* 1905 ■ *Meligethes coracinus* 1870s ■ *Meligethes corvinus* 1873 ■ *Meloe autumnalis* 1952
■ *Meloe cicatricosus* 1906 ■ *Meloe mediterraneus* 1800s ■ *Meloe variegatus* 1882 ■ *Murmidioides ovalis* 1831



Knots and grey plovers – internationally important

England's natural treasures

Amongst our great diversity of species is a small number of groups for which the country is internationally important. This may be because the groups are exceptionally diverse, because they are unusual or range-restricted or because the sheer numbers of individuals involved constitute large fractions of their international totals. There are also groups of species for which we have special international responsibilities for their conservation – species found nowhere else,

for example, and those which are very rare at a global scale. Five groups of species in England are considered outstanding in an international context:

- Atlantic ferns, mosses and lichens
- Breeding seabirds
- Wintering and passage waterbirds and gulls
- Grassland and woodland fungi
- Heathland invertebrates.

England's lost species

■ *Mycterus curculioides* 1882 ■ *Nephus bisignatus* 1800s ■ *Obrium cantharinum* 1929 ■ *Paederus rubrothoracicus* 1870
■ *Philonthus confinis* 1902 ■ *Plagionotus arcuatus* 1800s ■ *Platycerus caraboides* (Blue stag beetle) 1839 ■ *Pleurophorus caesus* 1890 ■ *Polyphylla fullo* mid-1800s ■ *Pterostichus aterrimus* 1973 ■ *Rhynchites auratus* 1839 ■ *Rhynchites bacchus* 1843

Atlantic ferns, mosses and lichens

The Atlantic community of ferns, mosses and lichens (termed cryptogams – plants that reproduce using spores instead of seeds) has developed along the eastern Atlantic seaboard in the warm, moist climate produced by the Gulf Stream. A relatively unpolluted atmosphere and a high level of rainfall promote the luxuriant growth and survival of an impressive array of species, many of which have close relatives in tropical areas. This



Fissidens polyphyllus, the largest British species of this distinctive genus of moss and an extremely rare plant of our Atlantic cryptogamic communities.

community is particularly well-represented along the Cornish and north Devon coasts and in the southern Lake District, and also in Scotland and Wales. Sheltered microclimates afforded by the rugged topography and deeply faulted fissures of the Wealden sandstones, and to a lesser extent the millstone grits of northern England, support a smaller sub-set of these special plants, including the filmy ferns, which are present in globally significant populations.

Breeding seabirds

England's seas provide food for enormous numbers of seabirds. A total of 41 species feed regularly in English waters, including the globally threatened Balearic shearwater.



Almost 5 per cent of the global population of shags live in English coastal areas.

Twenty two species breed regularly along the coast of England. The English populations of six of these species equate to 1-5% of the global totals. The herring gull total is 18% of the global total of birds of the race *argenteus* and that of the lesser black-backed gull approaches a quarter of the global total. Little terns and Sandwich terns form 8% of the European populations.

Wintering and passage waterbirds and gulls

An estimated 5 million wildfowl and waders (together termed waterbirds) and gulls are present in England in winter and at times of spring and autumn passage. Sites supporting 20,000 or more waterbirds are recognised as internationally important – between 35 and 40 inland and coastal wetlands in England regularly support such numbers, with fourteen of these, and an additional 12, also supporting 20,000 or more gulls in winter. The five most important sites in Britain for wintering and

England's lost species

■ *Rhyncolus (Phloeophagus) gracilis* 1897 ■ *Rhyssemus germanus* 1800s ■ *Saprinus subnitescens* 1892 ■ *Selatossomus cruciatus* 1840 ■ *Strangalia attenuate* 1845 ■ *Tarsostenus univittatus* 1800s ■ *Tilloidea unifasciatus* 1877 ■ *Trichodes alvearius* 1800s ■ *Trichodes apiaris* 1830 ■ *Tychius polylineatus* 1909 ■ *Vibidia duodecimguttata* 1905



More than 25 per cent of the international population of redshank total is found in England in winter.

passage waterbirds are all in England. The Wash, which regularly supports 320,000 wildfowl and waders and a further 47,000 gulls in winter, is by far the most important in Britain and is one of the most important wetlands for waterbirds in Europe. A total of 35 species of wader, wildfowl and gulls are found on one or more English sites in numbers of international significance. The English populations of knot, grey plover, dunlin, redshank, bar-tailed godwit, pintail, brent goose, Bewick's swan, and the Svalbard population of barnacle goose and of black-headed and common gulls, each constitute 25 per cent or more of the species' international totals. Indeed the English populations of knot, and the Svalbard populations of brent and barnacle geese make up more than 50% of the international total.

Grassland and woodland fungi

Three groups of fungi, one associated with grassland, one closely associated with veteran trees and another associated with wooded habitats, are of international importance. 'Waxcap grasslands' occur on nutrient-poor soils and have a high fungal species diversity. They support a group of fungi including the colourful species of waxcap from which the

habitat gains its name: pink gills, floury false-waxcaps, fairyclubs and earthtongues.

England has some internationally outstanding examples of waxcap grasslands. Sites rich in grassland fungi are scarce and threatened at an international scale with the main threats coming from agricultural improvement, atmospheric nitrogen deposition, declines in grazing, and housing or other development.

England has more veteran trees than most other northern European countries and one group of fungi, including oak polypore, bearded tooth and the zoned rosette, dependent on veteran trees and a sustainable resource of large decaying timber, occurs in internationally important numbers. The rot caused by these fungi may be of importance to the longevity of these trees as hollow trees are less prone to wind-throw.



Pink waxcap, a key species in waxcap grasslands.

Also of international importance and closely associated with wooded habitats, are the thermophilous or warmth loving boletes. They include royal bolete, the pretender and devil's bolete. These summer-fruiting species form close associations with both mature and veteran trees in open woodland and parkland.

England's lost species

Birds ■ *Charadrius alexandrinus* (Kentish plover) 1928 ■ *Chlidonias niger* (Black tern) 1840s-1850s ■ *Crex crex* (Corncrake) early-1990s ■ *Haliaeetus albicilla* (White-tailed eagle) late-1700s ■ *Jynx torquilla* (Wryneck) 1970s ■ *Lagopus mutus* (Ptarmigan) 1700s ■ *Lanius collurio* (Red-backed shrike) 1988 ■ *Otis tarda* (Great bustard) 1833

Heathland invertebrate communities

England's lowland heathlands are acknowledged as being of international significance. They support a series of nationally important invertebrate assemblages representing the entire succession from bare ground to mature semi-shaded wooded heath. The heathlands also support some species in internationally important numbers. The Dorset heaths, for example, support probably the largest colony of Purbeck mason wasp in the world. Many heathland species require different stages of heathland succession (eg open ground, dwarf shrub). None can survive on small, isolated sites or those maintained at one stage in that succession.

They require a landscape-scale approach to heathland management that encompasses continuous change, so much still needs to be done to secure their future in England.



The very rare ladybird spider is found on a very small number of heathland sites in Dorset.

Our international responsibilities for species

We have special responsibility for those species found in England and nowhere else in the world. At least 40 species endemic to England (2 fish, 2 mosses, 4 invertebrates, 9 lichens and 23 vascular plants). Loss of these would be global extinction. We have similar responsibilities for those English species

endemic to the UK and nearby Europe (including 38 vascular plant species, 4 mosses, 3 liverworts and 35 sub-species of birds). We also have special responsibility for 54 species occurring in England that are threatened by global extinction (Table 1).

Table 1 Internationally threatened: English species on the IUCN Global Red List

Critically Endangered		
Species Group	Common name	Scientific name
Birds	Eskimo curlew	<i>Numenius borealis</i>
	Balearic shearwater	<i>Puffinus mauretanicus</i>
Reptiles	Leatherback turtle	<i>Dermochelys coriacea</i>
Fish	Sturgeon	<i>Acipenser sturio</i>
	European eel	<i>Anguilla anguilla</i>
	Arctic Char	<i>Salvelinus lonsdalii</i>
	Blue skate	<i>Dipturus batis</i>
	Angel shark	<i>Squatina squatina</i>
Bivalves	Spengler's freshwater mussel	<i>Margaritifera auricularia</i>
Mosses		<i>Thamnobryum angustifolium</i>
		<i>Weissia multicapsularis</i>
Vascular plants		<i>Sorbus wilmottiana</i>

Endangered		
Species Group	Common name	Scientific name
Cetaceans	Sei whale	<i>Balaenoptera borealis</i>

England's lost species

■ *Pinguinus impennis* (Great auk) 1820s ■ *Tetrao urogallus* (Capercaillie) 1500s **Bugs** ■ *Macropsis glandacea* 1800s **Butterflies** ■ *Aporia crataegi* (Black-veined white) 1890s/1920s ■ *Argynnis niobe* (Niobe fritillary) 1895 ■ *Boloria dia* (Weaver's fritillary) c1890 ■ *Carcharodus alceae* (Mallow skipper) c1925

	Blue whale	<i>Balaenoptera musculus</i>
	Fin whale	<i>Balaenoptera physalus</i>
	Northern right whale	<i>Eubalaena glacialis</i>
Fish	Schelly	<i>Coregonus stigmaticus</i>
	Vendace	<i>Coregonus vandesius</i>
	Dusky grouper	<i>Epinephelus marginatus</i>
	Atlantic halibut	<i>Hippoglossus hippoglossus</i>
	Red porgy	<i>Pagrus pagrus</i>
	Undulate ray	<i>Raja undulata</i>
	White skate	<i>Rostroraja alba</i>
Bivalves	Freshwater pearl mussel	<i>Margaritifera margaritifera</i>
Vascular plants	Whitebeam	<i>Sorbus bristoliensis</i>
Mosses		<i>Ditrichum cornubicum</i>

Vulnerable		
Species Group	Common name	Scientific name
Cetaceans	Sperm whale	<i>Physeter macrocephalus</i>
Birds	Aquatic warbler	<i>Acrocephalus paludicola</i>
	Great bustard	<i>Otis tarda</i>
Fish	Atlantic cod	<i>Gadus morhua</i>
	Haddock	<i>Melanogrammus aeglefinus</i>
	Thresher shark	<i>Alopias vulpinus</i>
	Thorny skate	<i>Amblyraja radiata</i>
	Basking shark	<i>Cetorhinus maximus</i>
	Tope shark	<i>Galeorhinus galeus</i>
	Shortfin mako	<i>Isurus oxyrinchus</i>
	Porbeagle	<i>Lamna nasus</i>
	Sandy ray	<i>Leucoraja circularis</i>
	Common smoothhound	<i>Mustelus mustelus</i>
	Angular rough shark	<i>Oxynotus centrina</i>
	Smooth hammerhead	<i>Sphyrna zygaena</i>
	Spurdog	<i>Squalus acanthias</i>
Crustaceans	White-clawed crayfish	<i>Austropotamobius pallipes</i>
Insects	Dark guest ant	<i>Anergates atratulus</i>
	Greater capricorn beetle	<i>Cerambyx cerdo</i>
		<i>Graphoderus bilineatus</i>
		<i>Myrmica hirsuta</i>
Cnidarians	Pink sea fan	<i>Eunicella verrucosa</i>
	Starlet sea anemone	<i>Nematostella vectensis</i>
Vascular plants		<i>Sorbus anglica</i>
		<i>Sorbus eminens</i>
		<i>Sorbus subcuneata</i>
		<i>Sorbus vexans</i>
Lichens	Marsh earwort	<i>Jamesoniella undulifolia</i>

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■ *Carterocephalus palaemon* (Chequered skipper) 1976 ■ *Chazara briseis* (The Hermit) c1850 ■ *Cyaniris semiargus* (Mazarine blue) 1903 ■ *Euchloe simplonia* (Mountain dappled white) ■ *Iphicles podalirius* (Scarce swallowtail) c1850 ■ *Lasiommata maera* (Large wall brown) c1935 ■ *Lycaena dispar* (Large copper) 1864



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 ■ *Dasyopogon 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



Spotted sulphur, lost 1960



Black backed meadow ant, lost 1988



Burbot, lost 1960



Lynx, lost first century



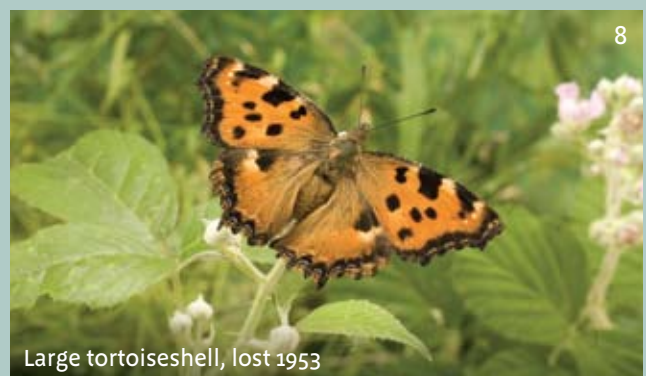
Ivell's sea anemone, lost 1983



Irish lady's-tresses, lost 1990s



Red backed shrike, lost 1988



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.

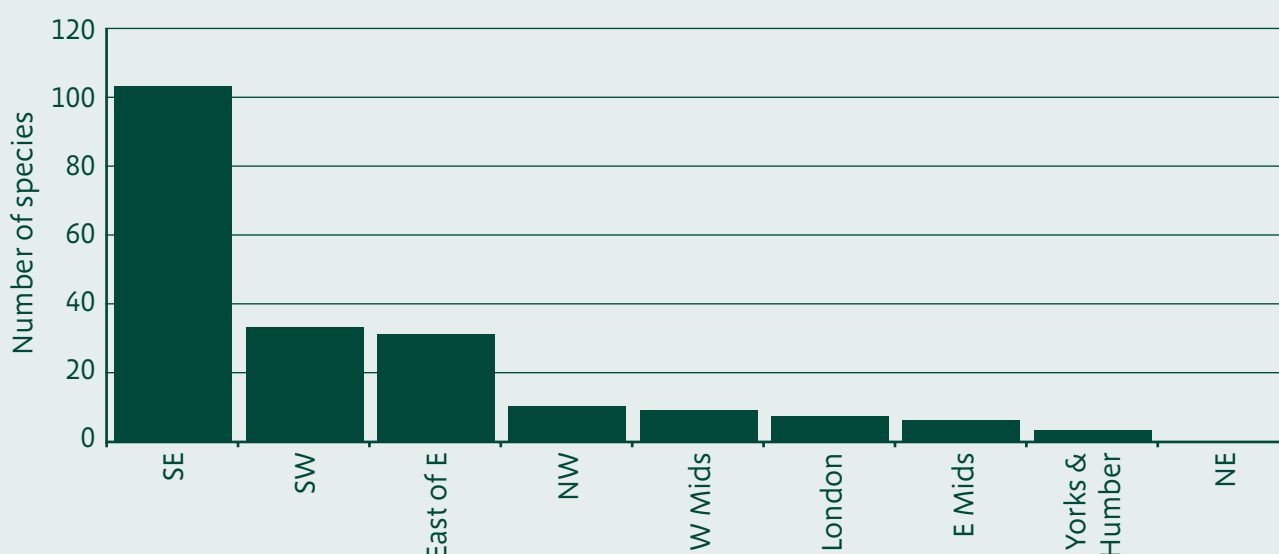
Patterns of loss in invertebrates

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.

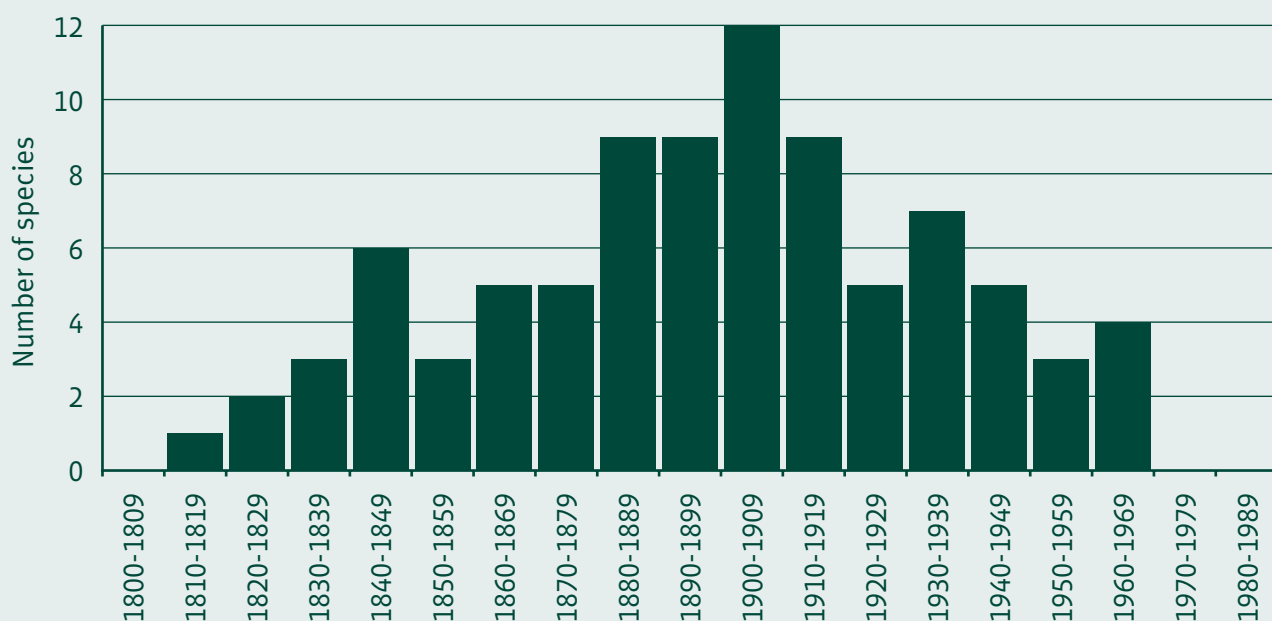
Figure 1 Last records of now extinct invertebrate species by English region, 1800-1996



England's lost species

■ *Platypalpus ochrocer* 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.

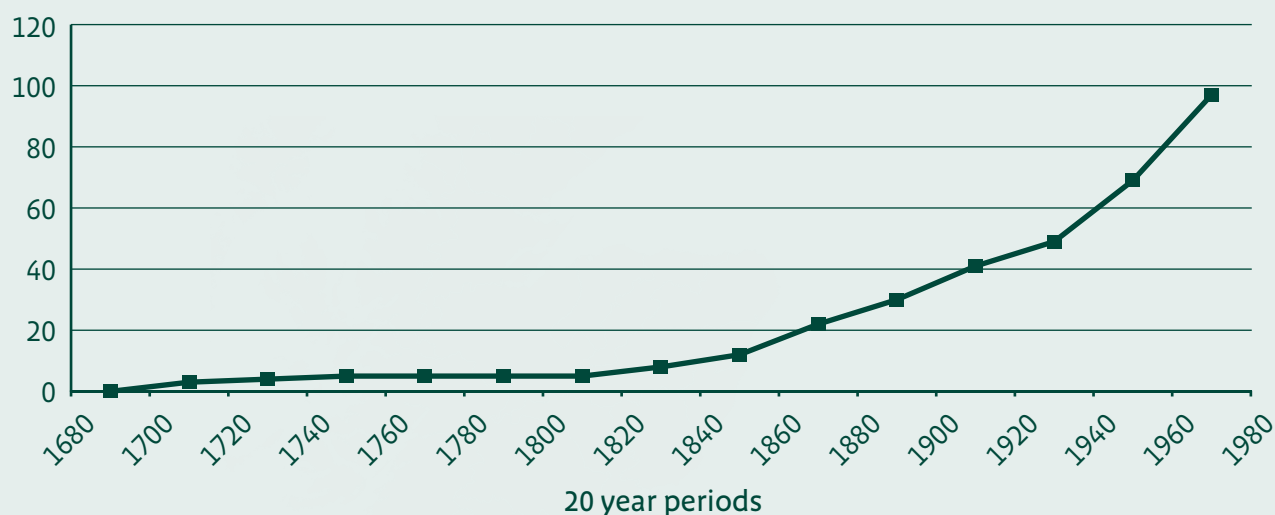
Predictors of plant species loss

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

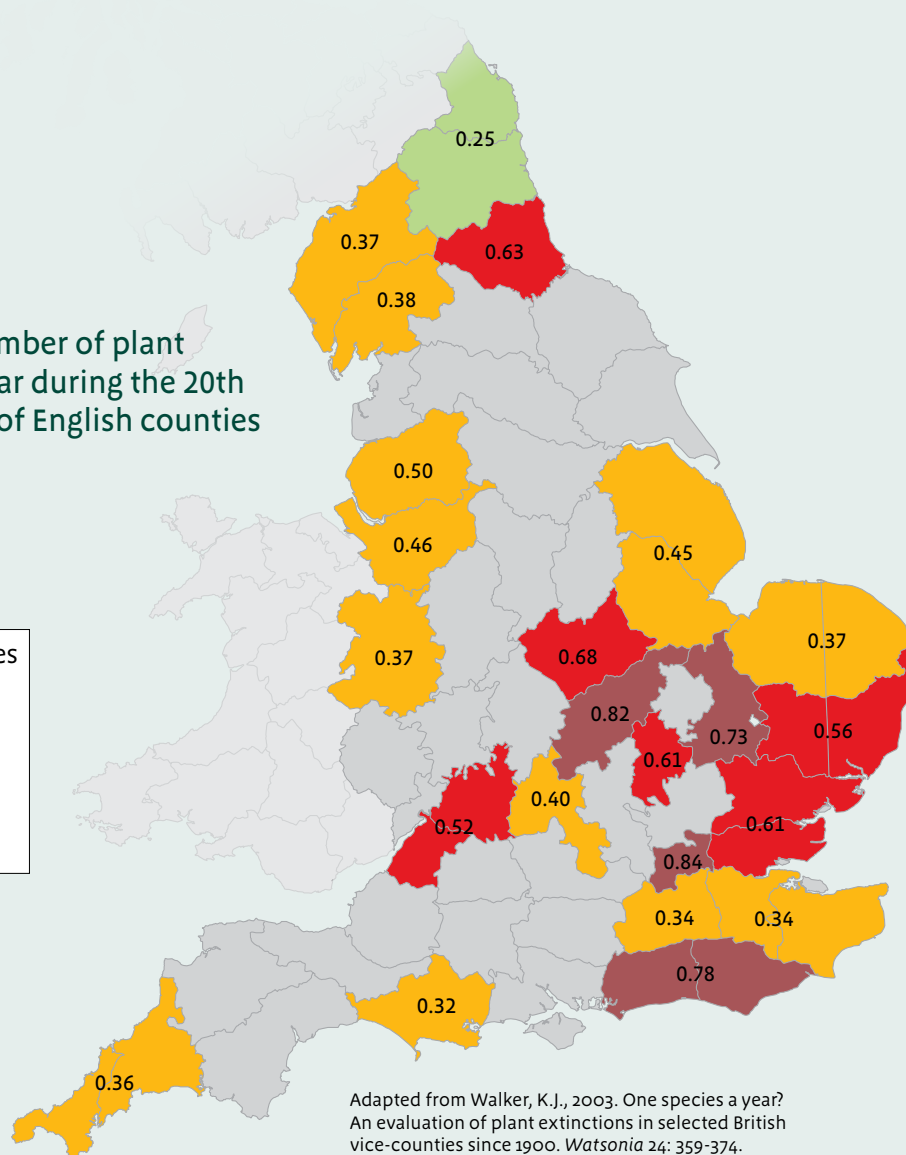
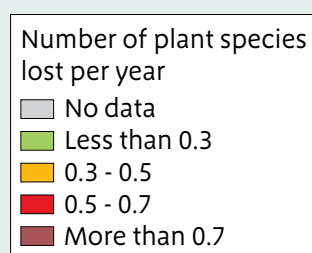
- *Bauhinus pustulatus* 1924 ■ *Bovistella radicata* (Rooting puffball) 1952 ■ *Clavariadelphus ligula* 1953
- *Clavariadelphus truncatus* 1924 ■ *Clavicornia pyxidata* (Candelabra coral) 1920 ■ *Cortinarius cumatilis* 1868
- *Doassansia limosellae* 1929 ■ *Geoglossum peckianum* 1910 ■ *Gomphus clavatus* (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 duriaana* 1902 ■ *Hygrophorus erubescens* (Blotched woodwax) 1877 ■ *Hygrophorus russula* (Pinkmottle woodwax) 1903 ■ *Ipicodon pendulus* 1831 ■ *Jamesdicksonia irregularis* 1959 ■ *Leptoporus mollis* 1957 ■ *Lycoperdon decipiens* (Steppe puffball) 1923

Great auk – the lost ‘penguin’ of the North Atlantic

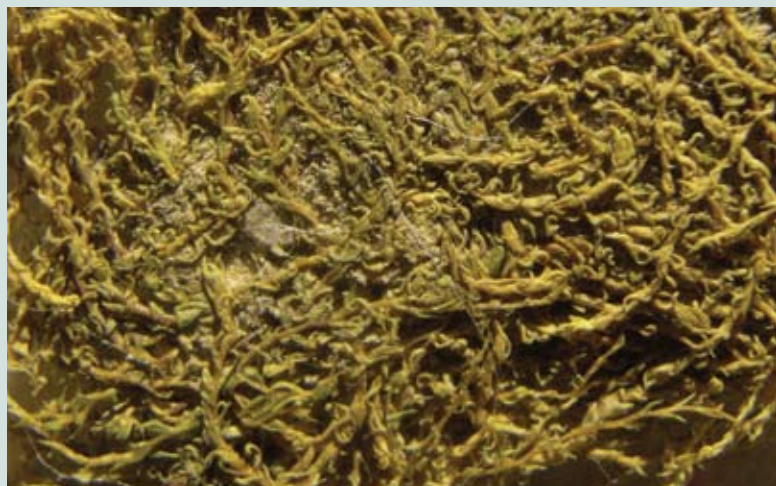
The great auk was a large, flightless seabird which bred in large numbers on islands across the North Atlantic. By the 18th century it had become confined by relentless persecution (by sailors for food, feathers and fuel oil) to the most remote islands, notably off Iceland and, especially, Funk Island 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 Eday, 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



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

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.

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 regal*is (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	Oysterplant
Angel shark	Tower mustard
Scotch argus butterfly	The moss <i>Seligeria diversifolia</i>
The bumblebee <i>Bombus humilis</i>	The stonewort <i>Chara aculeolata</i>



2 North West

White-tailed eagle	Burnt orchid
Chough	Slender naiad
Scarce crimson and gold moth	The moss <i>Byrum cyclophyllum</i>
The robberfly <i>Dasypogon diadema</i>	The liverwort <i>Diplophyllum taxifolium</i>



5 West Midlands

Twite	The hister beetle <i>Hister illigeri</i>
Marsh warbler	Bog orchid
Chalkhill blue butterfly	Various-leaved pondweed
The micro-moth <i>Lyonetia prunifoliella</i>	The moss <i>Gyroweissia reflexa</i>



6 East of England

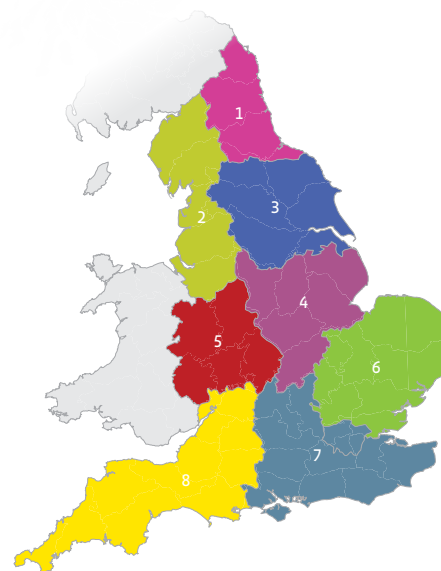
Red squirrel	The bumblebee <i>Bombus cullumanus</i>
Great bustard	Marsh fritillary butterfly
Burbot	Yellow centaury
Dainty damselfly	The stonewort <i>Nitella capilaris</i>



England's lost species

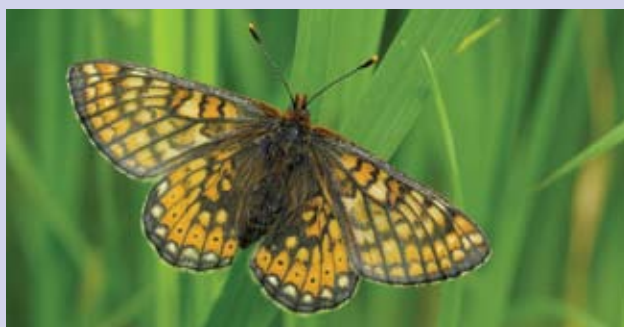
■ *Urocystis primulicica* 1904 ■ *Uromyces colchici* 1800s ■ *Uromyces tuberculatus* 1944 ■ *Ustanciosporium gigantosporum* 1865 ■ *Ustanciosporium majus* 1939 ■ *Ustilago corcontica* 1944 ■ *Ustilago marina* (Spike rush smut) 1885 ■ *Xylaria bulbosa* 1911 ■ *Xylaria digitata* 1924 ■ *Xylaria hippotrichoides* 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 occurred in each region.



3 Yorkshire and the Humber

Black tern	Cowbane
Stone curlew	Lizard orchid
Marsh fritillary butterfly	The moss <i>Aulacomnium turgidum</i>
The weevil <i>Coniocleonus hollbergii</i>	The liverwort <i>Scapania praetervisa</i>



4 East Midlands

Pool Frog
Thwaite shad
The bumblebee <i>Bombus humilis</i>
Chequered skipper butterfly
Wood white butterfly
The stonefly <i>Isoperla obscura</i>
Great sundew
Lizard orchid



7 South East and London

Greater horseshoe bat	Orange-spotted emerald dragonfly
Puffin	The stonewort <i>Chara intermedia</i>
The bumblebee <i>Bombus pomorum</i>	Mountain everlasting
Blue stag beetle	Crested cow-wheat



8 South West

Greater mouse-eared bat	The moss <i>Byrrum salinum</i>
Roseate tern	Tawny earwig
Gannet	The stonewort <i>Nitella hyaline</i>
Natterjack toad	
Irish lady's tresses	



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



Natterjack toad – threatened

Threatened species

In addition to species that have already been lost, others have been reduced in range and numbers to the point that they are vulnerable to extinction in England.

BAP priority species

The England Biodiversity Strategy sets out the action and co-ordinating framework needed to halt biodiversity loss and to rebuild our natural environment. At the UK level, Biodiversity Action Plan (BAP) priority species have been identified in order to give strong direction to where we need to focus our conservation efforts. The UK BAP prioritises those species that are globally threatened and species whose populations are in rapid decline (by 50 per cent or more in range or numbers over the last 25 years). It also identifies species that occur in the

UK in internationally important numbers but are in 'moderate' decline (by at least 25 per cent or more in range or numbers), as well as other species whose populations are considered to be threatened in the UK.

The UK BAP species that occur in England have been listed as species of 'principle importance for the conservation of biological diversity' under section 41 of the Natural Environment and Rural Communities Act 2006. Table 3 provides a summary of the number of species involved for each major species group where we have detailed information on English numbers. The proportion of native species listed as BAP priority species varies considerably between groups – ranging from 0-100 per cent, with rates of 30 per cent or more in the reptiles, whales and dolphins, amphibians, freshwater

England's lost species

Lichens ■ *Arthonia galactites* 1879 ■ *Arthothelium spectabile* ■ *Bacidia auwerswaldii* 1937 ■ *Bacidia beckhausii* ■ *Bacidia polychroa* ■ *Biatora cuprea* 1975 ■ *Biatoridium monasteriense* 1981 ■ *Brigantiaea fuscolutea* 1960 ■ *Bryoria nadvornikiana* 1995 ■ *Buellia asterella* 1992 ■ *Calicium abietinum* ■ *Calicium quercinum* ■ *Caloplaca atroflava* 1973

fish, terrestrial mammals, butterflies and stoneworts. Species on this list usually benefit from targeted conservation action but even this is not always enough: seven BAP priority species have gone extinct in England since the publication of the first UK BAP list in the late 1990s (the bordered gothic, orange upperwing and Brighton wainscot moths, the starry breck-lichen, Irish lady's tresses orchid, Pashford pot beetle and a diving beetle *Laccophilus poecilus*).

Table 3 Number of UK BAP priority species in England, ordered by percentage in group

A full list of priority species can be found at www.ukbap.org.uk

Major groups of plants and animals	Number of native English species	Number that are BAP priority species	Percentage that are BAP priority species
Reptiles	7	7	100
Mammals – regularly occurring whales and dolphins	13	12	92
Amphibians	9	4	44
Freshwater fish	37	14	38
Mammals – terrestrial (including seals)	49	16	33
Butterflies	75	24	32
Algae - stoneworts	29	9	31
Birds (residents and regular visitors)	281	54	19
Ants	50	7	14
Grasshoppers and crickets	28	4	14
Marine fish	275	28	10
Vascular plants	1,307	128	10
Liverworts	252	22	9
Mosses	679	61	9
Bees	265	20	8
Lichens	1438	99	7
Moths	2530	142	6
Dragonflies and damselflies	40	2	5
Spiders	640	31	5
Wasps	236	8	3
Water beetles	391	11	3
Stoneflies	34	1	3
Bugs	561	10	2
Hoverflies	264	5	2
Caddisflies	196	4	2
Mayflies	52	1	2
Fungi	>12,000	61	<1
Hornworts	4	0	0

The table does not include every species that appears on the BAP list – those 158 not listed are in groups for which we do not know the number of species native to England.

England's lost species

■ *Caloplaca borneri* ■ *Caloplaca haematites* ■ *Caloplaca pollini* ■ *Chaenotheca phaeocephala* ■ *Chaenothecopsis debilis* 1846 ■ *Cladonia cenotea* ■ *Cladonia peziziformis* 1968 ■ *Cladonia phyllophora* ■ *Collema conglomeratum* ■ *Collemopsidium argilospilum* ■ *Dictyonema interruptum* 1959 ■ *Diplotomma pharcidium* 1879 ■ *Hypogymnia vittata*

Other species causing concern

The BAP priority species are not the only ones for which we have concern. For example, we know that an additional 36 bird species have undergone a decline of 25-50 per cent in range or numbers over the last 25 years, but these do not qualify as BAP species as they do not occur in the UK in internationally important numbers. Whilst it is highly likely that species in other groups also fall into this category, we do not have the information on recent population trends that would allow us to make a comprehensive analysis of these groups.

In a small number of groups (those for which there is an excellent written record of their abundance in earlier times) we also know that some species have been in decline over much longer periods – perhaps over many decades or even a century or more. It is evident that some of these species now occupy a range or occur in numbers which are a shadow of former times. Yet they may no longer be in decline and nor are they completely lost. Without restoration of these depleted populations there is a risk

of further extinctions. The identification of historically declining species relies on records of distribution and abundance. Whilst for most groups this simply does not exist, we have sufficient information to indicate that we should add an additional mammal, eight breeding birds, two freshwater fish, two butterflies, two bumblebees and no less than 194 vascular plants to our list of species for which we have conservation concern.

The overview of nine well-studied groups in Table 4 indicates that from 0-24 per cent of the species in these groups are lost, with a further 24-100 per cent of species either depleted or listed on the UK BAP list of priority species. An average of these values, but ‘weighted’ by the number of native species in each of the groups, indicates that over a quarter of extant species (26%) are depleted or appear on the UK BAP list. We do not know whether similar rates apply in the less well-studied groups, but these figures certainly give considerable cause for concern.

Table 4 Overall loss, depletion and decline in better-studied groups, ordered by percentage threatened

Species group	Total number of native English species	Number (percentage) that are now lost	Number of extant species	Number of extant species on the UK BAP list	Number not on BAP list but with historically depleted populations	Proportion of extant species with historically depleted populations or on BAP list
Reptiles	7	0 (0%)	7	7	0	100%
Mammals – regularly occurring whales and dolphins	13	2 (15%)	11	11	0	100%
Amphibians	9	2 (22%)	7	4	0	57%
Freshwater fish	37	2 (5%)	35	13	2	43%

England’s lost species

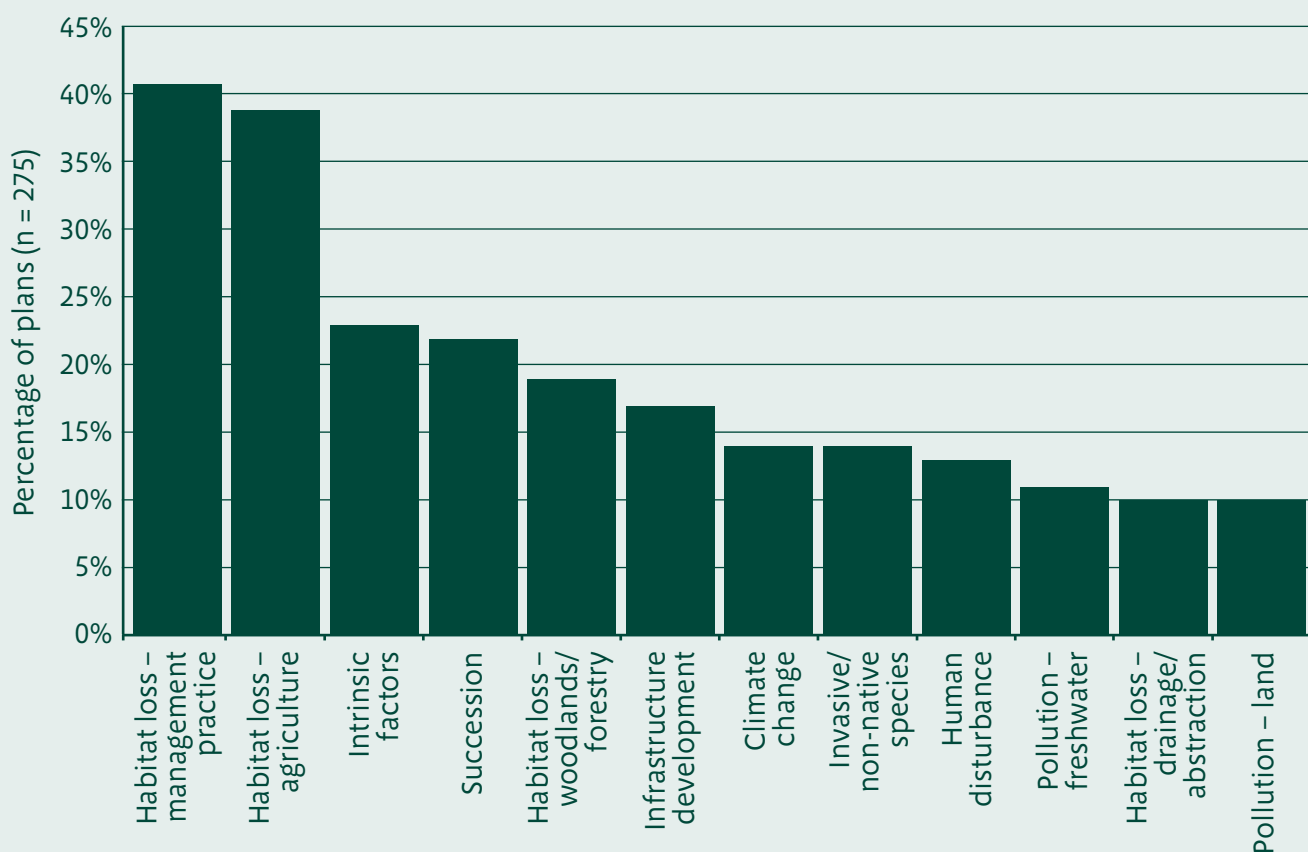
■ *Lecania coeruleorubella* ■ *Lecania olivacella* ■ *Lecanora frustulosa* ■ *Lecanora populicola* ■ *Lecidella pulveracea*
 ■ *Leptogium burgessii* ■ *Leptogium hildenbrandii* ■ *Leptogium saturninum* ■ *Melaspilea leciographoides*
 ■ *Menegazzia subsimilis* ■ *Orphniospora moriopsis* ■ *Peltigera malacea* ■ *Pseudocyphellaria norvegica* ■ *Pyrenula nitidella*

Mammals – terrestrial (including seals)	49	6 (12%)	43	15	1	37%
Bumblebees	24	4 (17%)	20	5	2	35%
Butterflies	75	18 (24%)	75	23	2	33%
Breeding birds	185	10 (5%)	175	40	8	27%
Vascular plants	1,307	20 (<2%)	1297	121	194	24%

Information here may differ from that in earlier tables as it is re-presented here to ensure strict mutual exclusion between categories.

The factors driving decline in populations of BAP priority species are generally better known than the factors which led to the total loss of species from England. Habitat loss and degradation are factors that affect most BAP priority species, along with widespread impacts of air and water pollution, and intrinsic factors such as low population size and limited dispersal abilities. Agricultural intensification (such as increased levels of grazing and the use of fertiliser and pesticides) and changes in management practices are the most important underlying causes of species decline, followed by infrastructure developments, habitat succession and the effects of invasive non-native species. Figure 5 shows the most significant threats to BAP priority species.

Figure 5 The most significant threats faced by BAP priority species in 2008



Source: Biodiversity Action Plan Reporting System, 2009; Natural England

England's lost species

■ *Sclerophora farinacea* ■ *Spironema paradoxum* ■ *Stereocaulon condensatum* ■ *Thelenella modesta* ■ *Thermutis velutina*
 ■ *Toninia opuntioides* ■ *Toninia tumidula* ■ *Tornabea scutellifera* ■ *Usnea silesiaca* ■ *Vulpicida juniperinus* **Liverworts**
 ■ *Diplophyllum taxifolium* 1950s ■ *Fossombronina mittenii* (Mitten's frillwort) 1972

The red squirrel – lost to an alien invasion

The red squirrel is native to England and was widespread here until about 70 years ago. In the last quarter of the 19th century, the grey squirrel was introduced to various parts of the UK from North America. It has had a devastating impact, replacing the native species whenever the two come into contact and causing significant damage to forestry through its bark-stripping activities. The red squirrel is now confined to the Isle of Wight and the Poole Harbour islands, where there are no grey squirrels, and an area of northern England, mainly in Cumbria and Northumberland, into which grey squirrels are continuing to expand. This replacement has involved two factors. Firstly, grey squirrels out-compete red squirrels in most, if not all, types of woodland, perhaps because they are larger, live at higher density and are better adapted to foraging in

broadleaved woodland than the red squirrel, which evolved in northern coniferous forests. Secondly, the grey squirrel carries a virus, squirrelpox, which does not cause it any harm, but is almost invariably fatal to red squirrels. Where the virus is present in grey squirrels they replace the reds much faster.

Maintaining mainland populations of red squirrels will be difficult. The primary conservation strategy has been to identify large forest strongholds where the forest type minimises the competitive advantage of the grey squirrel, and defend these against grey squirrel incursions by organised trapping and removal in a surrounding buffer. Nevertheless it is highly likely that all mainland red squirrel populations will be lost within the next 20-30 years, unless effective action is taken.



Red squirrel – threatened

England's lost species

■ *Liochlaena lanceolata* (Long-leaved flapwort) 1966 ■ *Scapania praetervisa* 1952 **Mammals** ■ *Canis lupus* (Wolf) late-1200s ■ *Castor fiber* (Beaver) late-1700s ■ *Eschrichtius robustus* (Grey whale) 1600s ■ *Eubalaena glacialis* (Northern right whale) mid-1800s ■ *Felis silvestris* (Wildcat) late-1800s ■ *Lynx lynx* (Lynx) early first century

The northern bluefin tuna – fished to the brink



Recreational sea anglers off Scarborough enjoying a good haul of bluefin tuna in 1933

The northern bluefin tuna is the largest of the tunas. It can grow to a length of over two metres and weigh more than 500 kg. In England, observations of bluefin tuna in the North Sea date back to 1912, when government fisheries staff recorded bluefin schools feeding on the herring falling from fishing nets as they were being hauled aboard. They had little value then and were often used for pet food or discarded.

This situation began to change during the 1930s as a tuna sport fishery developed between Scarborough and the Dogger Bank. English sport fishery landings began to be recorded in 1932, with annual catches ranging from 20 to 80 fish per year. At roughly the same time, the Norwegians were developing a bluefin fishery and by 1949, a total of 43 boats were involved. In just one year, this figure leapt to over 200 vessels. Annual catches of over 10,000 tonnes were common during the 1950s and

represented a large proportion of the entire North Sea tuna catch. By the 1960s catches had collapsed and the abundance of bluefin tuna in the waters around England is now considered too low to support commercial or recreational fishing. Whilst factors such as ocean temperature changes may have affected the population, the main reason for the collapse would appear to be over fishing.

A single tuna recently sold in Japan for £110,000 so, in addition to pressures from legal fishing, there is a large illegal fishery. The International Commission for the Conservation of Atlantic Tunas (ICCAT) estimated that, in 2007, the illegal landings were equal to that of the legal fishery. Recent calculations suggest that the adult population in 2011 will be 75 per cent lower than 2005 and that fishing quotas will permit the capture of all the remaining adult fish. There would seem to be little hope for the survival of the northern bluefin tuna.

England's lost species

■ *Myotis myotis* (Greater mouse-eared bat) 1985 ■ *Ursus arctos* (Brown bear) late first century **Mayflies** ■ *Arthroplea congener* 1920 ■ *Heptagenia lonicauda* 1933 **Mosses** ■ *Andreaea mutabilis* (Changeable rock-moss) 1950s ■ *Aplodon wormskjoldii* (Carrion-moss) 1974 ■ *Aulacomnium turgidum* (Swollen thread-moss) 1878 ■ *Bartramia stricta* (Upright apple-moss) 1864

The natterjack – a toad in a hole

At the start of the 20th century, the strident call of natterjack toads could be heard in many areas with shallow, temporary pools in a sandy landscape. Natterjacks were common in parts of the southern and eastern counties, and along the Irish Sea coast.

There has since been a substantial decline of natterjack habitat, due to agricultural intensification, pond acidification and development for housing, holiday parks and golf courses. Additionally, scrub encroaching onto dunes and heathlands, often due to reduced grazing, has resulted in the common toad replacing natterjacks. A typical 'pioneer species', the natterjack is rapidly out-competed by its closely related cousin when habitats become more fixed and densely vegetated.

By 1970, only 43 natterjack populations remained in England. In the space of a century, natterjacks had lost around 80 per cent of their range. Furthermore, many colonies that survived were reduced in size, connectivity and security.

More recently there have been two further threats. The decline in the natterjack population at Saltfleetby, Lincolnshire, despite intensive habitat enhancement, has occurred because it is genetically impoverished due to its isolation from other colonies for many decades. And recently, a potentially lethal fungus has been detected in natterjack toad populations.

Research, trial habitat management, intensive monitoring and re-introductions have led to some recovery, and there are now around 50 populations.

Recorded range of the natterjack toad, 1948-2009



Recorded range of the natterjack toad in Great Britain, from 1948-2009. Note: there was additional decline prior to 1948, but precise data are not available. Units are 10x10 km squares, derived from surveys. Data from: Amphibian and Reptile Conservation and from Beebee, TJC, Wilkinson, JW & Buckley, J, 2009, Amphibian declines are not uniquely high amongst the vertebrates: trend determination and the British perspective. Diversity 2009, 1, 67-88.

England's lost species

■ *Bryum calophyllum* (Matted bryum) 1983 ■ *Bryum cyclophyllum* (Round-leaved bryum) 1930s ■ *Bryum turbinatum* 1940s ■ *Bryum uliginosum* (Cernous bryum) 1950s ■ *Ceratodon conicus* (Scarce redshank) 1991 ■ *Conostomum tetragonum* (Helmet-moss) 1950s ■ *Cynodontium polycarpon* 1960s ■ *Dicranum elongatum* (Dense fork-moss) late-1800s

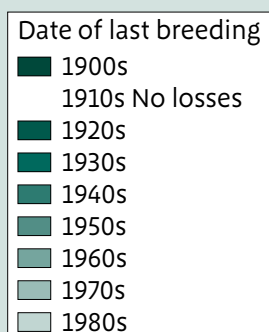
The corncrake – cut down in its prime

The corncrake once bred in meadows and grasslands in almost all English counties. The males arrived from their African winter quarters in late April and their loud, rasping call, delivered with particular vigour at night, gave many a country dweller sleepless nights. A decline in numbers was readily apparent by the start of the 20th century. A 'Land Rail Inquiry' undertaken in 1911 found that although large populations were found in the north of the country, they were already scarce or absent from much of central and southern England. Subsequent surveys in 1938 and 1939 found the bird breeding in 19 English counties but it was absent or very localised south of a line from north Shropshire to the Tees Estuary. Just 11-17 singing males were located in England during the 1978 & 79 surveys, eight during the 1993 and just two during the 2003 survey.

The cause of decline was the mechanisation and intensification of grassland management. Corncrakes are extremely reluctant to break cover, so many adults and chicks were killed and nests destroyed by machinery. The simple measures of cutting fields from the inside outwards, late cutting and the provision of tall vegetation at field margins have seen corncrake numbers increase substantially in the Western Isles of Scotland and such management has been introduced on a number of nature reserves and adjacent farmland in England. Corncrakes have recently been re-introduced into one such area, the Nene Washes in Cambridgeshire, and the early signs are encouraging. The bird is declining throughout its range and is recognised as globally-threatened, so action in England has international significance.



Decades in which English counties lost their regular breeding corncrake populations



England's lost species

- *Didymodon icmadophilus* 1950s
- *Eurhynchiastrium pulchellum* (Elegant feather-moss) 1980
- *Grimmia anodon* 1961
- *Gyroweisia reflexa* 1938
- *Helodium blandowii* 1901
- *Herzogiella striatella* (Muhlenbeck's feather-moss) 1950s
- *Kiaeria falcate* (Sickle-leaved fork-moss) 1950s
- *Paludella squarrosa* 1916

The large blue – fall and rise of a butterfly



Large blue – re-introduced

The large blue butterfly used to inhabit most counties across southern England, from Cornwall to Kent northwards to Northamptonshire and Herefordshire. It occurred in scattered colonies and was highly prized by collectors. Colonies in Kent, Hampshire, Buckinghamshire and Bedfordshire had gone by 1830. Seven Northamptonshire colonies, first discovered in 1837, were collected out by 1859. Of 33 sites where the large blue had been found in the Cotswolds, just six remained by the 1950s and the last was ploughed up in 1963. Of more than 30 sites on the north coast of Devon and Cornwall, most were gone by the 1950s, with the last colony dying out in 1973. The very last surviving colony in England, on south Dartmoor, finally died out in 1979. In all, 90 large blue colonies were recorded over a period of about 150 years.

The causes of the large blue's extinction in England include abandonment of burning and appropriate grazing management in its preferred habitat; ploughing of any land that could grow crops; and afforestation, urbanisation and quarrying of areas that were unsuitable for agriculture. Collectors then speeded up the final decline.

In 1983, a re-establishment project was launched using stock collected in Sweden. Success, built on sound science, secure funding and the efforts of volunteers and professionals, has seen the large blue returned to 35 sites in south-west England by 2009. However, much still needs to be done to restore this species to its former strongholds throughout southern and central England.

England's lost species

■ *Palustriella decipiens* (Lesser curled hook-moss) 1950s ■ *Philonotis tomentella* 1950s ■ *Pohlia prolifera* 1950s
■ *Pseudoleskeella rupestris* 1950s ■ *Pterygoneurum lamellatum* 1970 ■ *Schistidium frigidum* 1950s ■ *Seligeria diversifolia* 1971 ■ *Sphagnum obtusum* 1911 ■ *Sphagnum platyphyllum* (Flat-leaved bog-moss) 1950s

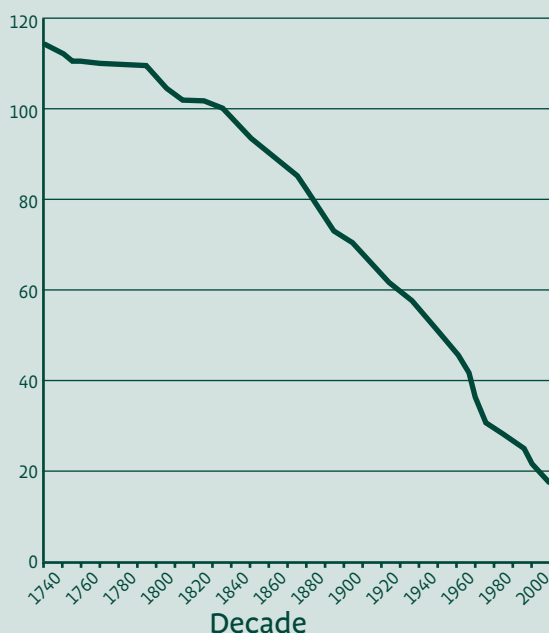
The pasque flower – a grazing solution in England

The pasque flower grows in short chalk and limestone grassland in England. Since its discovery in 1551 it has been recorded at around 120 sites. The majority of these were lost during the 18th and 19th centuries due to ploughing for arable cropping or mineral extraction and urban development.

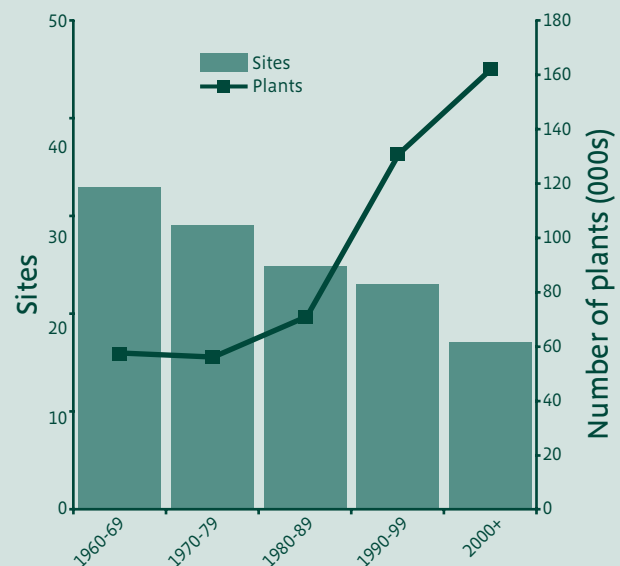
Only a quarter of populations remained by the mid-20th century, almost all on designated conservation sites. The plant subsequently disappeared from a further 16 sites due to lack of grazing (seven sites), ploughing (four sites), overgrazing (two sites) and the dumping of rubble on one site. Eighteen populations remain: five appear to be thriving, accounting for over 99 per cent of the entire English (and UK) population of some 162,000 plants. Ten populations support less than 50 individuals, many within grazing exclosures.

The main cause of decline has been a reduction in the level of grazing on small or isolated sites where livestock farming is no longer economically viable. Indeed, unless grazing is re-introduced to four sites soon, the plants may well be lost to them. Undergrazing enables coarse grass species to out-compete and shade other plants and to dominate the sward. The restoration of an appropriate level of grazing can have a marked positive effect, both on this species and on other chalk grassland specialities. Following the re-introduction of winter sheep grazing to sites holding three of the largest pasque flower colonies, the swards became significantly shorter and more herb-rich. The cover of the coarse grass species fell to about 10 per cent and the numbers of 'flowering' pasque flowers increased by 260 per cent.

(a) The decline in the number of pasque flower sites recorded in England



(b) Changes in the number of sites and plants recorded since 1960. Note that although the number of sites has declined, the overall population has increased due to the reinstatement of winter grazing on three sites.



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

England's lost species

■ *Sphagnum strictum* (Pale bog-moss) 1950s ■ *Tetradontium repandum* (Small four-tooth moss) 1958 ■ *Weissia mittenii* (Mitten's beardless-moss) 1970 **Moths** ■ *Acrolepiopsis betulella* ■ *Acrionicta auricoma* (Scarce dagger) 1912 ■ *Acrionicta strigosa* (Marsh dagger) 1933 ■ *Aethes margarotana* 1966 ■ *Agonopterix capreolella*



Grass-of-Parnassus – threatened

Our concerns for the future

The large number of rare or rapidly declining species makes it probable that further losses will occur in England. The choices that we make now and in the future will influence which species decline and which thrive.

In this section, we aim to help inform those choices by highlighting some of the threatened groups of species which we believe are of special concern.

England's lost species

■ *Agonopterix curvipunctosa* ■ *Apamea pabulatricula* (Union rustic) 1935 ■ *Apotomis infida* 1919 ■ *Archips betulana* 1881-1900 ■ *Arctornis l-nigrum* (Black V moth) 1960 ■ *Aristotelia subdecurtella* ■ *Augasma aeratella* 1950s ■ *Borkhausenia minutella* 1931 ■ *Caryocolum huebneri* ■ *Catocala fraxini* (Clifden nonpareil) 1964

1 Species now severely restricted in range

A large number of species in England have lost so much of their suitable habitat that they have become restricted to just a few sites. A total of 412 BAP priority species are known from fewer than five sites. Some of these species have always been rare, but many were formerly more widespread and populations would recover if more suitable habitat was available. There is a risk that many more of these species will be lost as a result of development or inappropriate site management.

Being confined to a few remnant, isolated sites also make these species much more vulnerable to climate change than they would otherwise be.



The shrill carder bumblebee was formerly widespread across southern England, but declined by 75% between 1970-90 and 1990-2000 due to loss of unimproved flower-rich grassland.

2 Internationally important wintering and passage waterbird populations

There are several changes that threaten our internationally important populations of waterbirds. Sea-level rise is already causing the loss of saltmarsh and changing the sediment structure, composition and dynamics of other intertidal areas, especially in eastern and

south-eastern England. This removes or alters important foraging and roosting grounds for these waterbirds.

There are also changes in distribution of these waterbird populations which are consistent with the impact of climate change. There is a marked shift of populations away from the south and west towards the north and east – including the east coast estuaries where the impacts of sea-level rise are greatest. If climate change leads to warmer winters it is predicted that many waterbirds will winter nearer to their breeding grounds (staying in continental Europe). Also populations may collapse because their Arctic breeding grounds become unsuitable following the melting of the permafrost and subsequent encroachment of forest. In either case, some of the populations of wintering and passage waterbirds in England may no longer retain their international importance.



Internationally important numbers of grey plover regularly overwinter in England. We anticipate significant change in numbers and distribution as our climate changes.

3 Internationally important breeding seabird populations

Some very worrying trends are apparent amongst our breeding seabird populations. Species including shag, herring gull and kittiwake are in steep decline and some of the

England's lost species

■ *Celypha doubledayana* c1900 ■ *Choristoneura lafauryana* 1962 ■ *Coleophora albella* 1985 ■ *Coleophora antennariella* c1930 ■ *Coleophora vibicigerella* 1980 ■ *Coleophora vulnerariae* ■ *Colobochyla salicalis* (Lesser belle) 1977 ■ *Conistra erythrocephala* (Red-headed chestnut) 1932 ■ *Cosmopterix schmidiella* 1901

smaller colonies, such as the kittiwake colony at Land's End, have recently been abandoned. Even where numbers are buoyant, breeding success may be poor and future decline in numbers and perhaps even colony abandonment is likely. Coinciding with such changes are increasing sea temperatures; changes in the distribution of plankton, fish, other seabird prey and of seabird predators; and changes in fishing effort, techniques and species targeted by fishing fleets. The relative importance of these factors in causing the observed trends is poorly understood. Some important seabird colonies are also declining in the presence of introduced non-native mammals including brown rat and mink. The productivity of birds at many beach colonies is also adversely affected by recreational disturbance.



Numbers of breeding kittiwakes declined by 40% between 1985-88 and 1998-2002.

4 Species associated with coastal habitats

Sea-level rise is already impacting upon many coastal habitats, through erosion and inundation with sea water. Some of the most important wetland sites in Suffolk,

for example, have already been effectively lost, while others have been inundated in the last ten years. This has potentially disastrous consequences for the specialist species that depend on them. Freshwater species at risk include bittern, black-tailed godwit, Norfolk hawk dragonfly, the little whirlpool ramshorn snail, sharp-leaved pondweed and several range-restricted stoneworts. Indeed, the bearded stonewort is now thought to be lost from all coastal localities. Several important sand lizard populations and a significant fraction of the national population of natterjack toads are also highly vulnerable to sea-level rise and catastrophic flooding events, as are the small number of remaining shore dock populations on the Isles of Scilly. Inappropriate hard sea defences lead to 'coastal squeeze', so brackish and saline habitats, unable to migrate landwards as sea levels rise, are eroded and lost. These threatened habitats support a suite of invertebrates and plants including the drift-line dependent BAP spiders *Arctosa fulvolineata* and *Baryphyma duffeyi*, the fancy-legged fly and coastal-specialist vascular plants such as annual sea purslane.



The dainty damselfly was first recorded near Benfleet in Essex in 1946. The storm surge of January 1953 submerged the known population and the dragonfly has not been seen since in mainland England.

England's lost species

■ *Costaconvexa polygrammata* (The Many lined) 1850s ■ *Cucullia gnaphalii* (The Cudweed) 1979 ■ *Cydia corollana* c1982 ■ *Cydia leguminana* 1976 ■ *Denisia augustella* ■ *Depressaria depressana* pre 1900 ■ *Depressaria discipunctella* early-1900s ■ *Depressaria emeritella* 1860 ■ *Dichomeris derasella* 1933 ■ *Eana argentana* c1986

5 Species losing their English 'climate space'

Climate change will have significant impacts on species that are intolerant of change in temperature and rainfall, are out-competed by more adaptable species, or cannot find suitable habitats within their shifting climate space. We have special concerns for our montane species, few of which are likely to remain. These species are at their southern distributional limits in England and are dependent on the snow-beds on the highest hills. They also face the problems of fragmentation, small population size and random factors such as rock-falls.



The alpine foxtail is one of a group of montane species confined to high altitudes mainly in the Lake District, North Pennines and Yorkshire Dales. Our population of alpine foxtail is the most southerly in the world.

At the other extreme, many of the areas of bare ground in the south of the country, such as the coastal landslips in the Isle of Wight and Dorset, may become intolerably hot and dry for the suite of invertebrates that currently inhabit them. However, they may be colonised by other species presently at their northern limit in England.

In areas that experience wetter and warmer winters, vegetation growth will become

more luxuriant, so bare ground and early successional habitats will be present for shorter periods, risking the loss, for example, of many heathland species. In contrast, however, our internationally important Atlantic lower plant communities appear to be thriving, with new colonies becoming established as our winters have become increasingly mild and wet.

6 Specialist farmland wildlife

The intensification of agricultural management since the Second World War has resulted in a profound decline in the diversity of wildlife on England's farmland as special habitat features and mosaics have been lost. In particular the intensive use of pesticides and fertilisers, the early and repeated cutting of grasslands, the ploughing and re-seeding of ancient grasslands, the loss of winter stubbles, the loss of mixed farms and a marked regional specialisation has resulted in major loss of specialist farmland species formerly found in our fields and hedgerows. Many once-abundant species including noctule bat, turtle dove, skylark, corn bunting, corncrake and a host of farmland-specialist flowering plants such as annual knawel and fine-leaved sandwort, as well as a large number of species of mosses and liverworts are now absent or rare across large swathes of their former range and hugely diminished in abundance.

Agri-environment schemes and other conservation action have included measures to reverse the losses of some farmland species. Despite these, and the conservation efforts of many individual farmers and landowners, there are major concerns over the impact of future farmland management on species. The loss of set-aside, the impact of management for bio-fuels, planting of genetically modified crops, all underpinned by the pressures for energy and food security, will put further stresses on farmland wildlife. Paradoxically, many small surviving patches of unimproved grassland, heathland and fen which have

England's lost species

■ *Emmelia trabealis* (Spotted sulphur) 1960 ■ *Epicallima formosella* 1840s ■ *Ethmia pusiella* ■ *Euclementia woodiella* 1829 ■ *Euhyponomeuta stannella* 1976 ■ *Eurhodope cirrigerella* (Hairy knot-horn) 1960 ■ *Fagivorina arenaria* (Speckled beauty) 1898 ■ *Gelechia cuneatella* ■ *Gibberifera simplana* ■ *Gnorimoschema streliciella*

survived within otherwise intensively managed landscapes are now threatened by a lack of grazing as they lie within purely arable enterprises. This will result in yet further declines in the specialist plants and animals confined to those habitats and which make traditionally managed English fields such a delight.

As England's climate warms and perhaps dries, intensive arable management is predicted to spread northwards and westwards, with some additional species, including our internationally important population of lesser horseshoe bat, likely to be adversely affected.



Hornworts such as *Anthoceros agrestis* are now rare on arable farmland. Modern cultivations without a fallow period do not allow them to complete their life cycle on over-wintered stubbles.

7 Long-distance migrants

There has been a worrying decline in the numbers of long-distance migrants visiting this country in recent years. Prominent among the losses are breeding birds that are summer visitors to England, undertaking a twice-yearly crossing of the Sahara. Whilst there is good evidence that the quality of their breeding habitat in England is deteriorating, the fact that most trans-Saharan migrants are

in decline suggests strongly that there are major problems outside England. These might include the loss or deterioration of wintering or staging habitats, or increases in hunting pressure.

There are also major declines in migratory fish. Stocks of salmonids (including salmon), twaite shad and allis shad have fallen markedly, and the European eel has now declined to the extent that it is regarded as critically endangered on a global scale. Sea and river pollution, as well as physical barriers such as weirs and barrages, pose the greatest threats to these species.



Before our rivers became grossly polluted, the Atlantic salmon was widespread throughout England. The Thames was probably the first river to lose its stock, around 1833, but others quickly followed. Recent improvements in sewage treatment and disposal, enforcement of drinking water standards and the installation of fish passes have promoted a considerable recovery, with salmon making a return to the Thames.

8 Predators exposed to illegal persecution

Past persecution removed many once-familiar species from the English countryside, including pine marten, wildcat and red kite. Sometimes extinctions have followed over-collecting of species which were already rare,

England's lost species

■ *Gypsonoma nitidulana* ■ *Hadena irregularis* (Viper's bugloss) 1968 ■ *Hecatera dysodea* (Small ranunculus) 1941
 ■ *Heliophobus reticulata* (Bordered gothic) 2001 ■ *Heliodines rosella* 1820 ■ *Hypercallia citrinalis* 1979 ■ *Idaea humiliate* (Isle of Wight wave) 1954 ■ *Isturgia limbaria* (Frosted yellow) 1914 ■ *Jodia croceago* (Orange upperwing) 1983

particularly in the Victorian era. The predators perceived to threaten livestock and game have been particularly affected. Illegal killing and other forms of persecution continue to restrict the range and numbers of species such as golden eagle, peregrine, hen harrier, goshawk and red kite. It may also begin to affect other species whose populations and ranges are currently recovering, including the raven, marsh harrier, otter, pine marten and polecat.



Human persecution resulted in the loss of the red kite in the 19th century and still results in unnecessary deaths of re-introduced birds today.

9 Native species under pressure from invasive non-natives

A large number of non-native species have been introduced into the English countryside, accidentally or deliberately. Most are scarce or restricted in range and appear to have negligible impact on native species or habitats. But in some cases non-native species become invasive, affecting native species in a great many ways. Some carry disease which spreads to native species. The native white-clawed crayfish, for example, is under considerable threat in England due to crayfish plague (introduced with the American signal crayfish) and is now globally threatened. Others out-compete native species. The Australian swamp stonecrop and least duckweed, for example, have now smothered many ponds, ditches and mires, removing space for other plants and blocking all light from entering the water.

Introduced deer such as fallow, sika and muntjac, exert a major influence on habitat structure in woodlands, significantly affecting their species composition. Many ground-nesting birds suffer high rates of predation from non-native mammals. There is concern that climate change may alter relationships between natives and introduced species and, in particular, may cause more rapid proliferation of some species.



Campylopus introflexus, perhaps the most widespread invasive organism in the British Isles, was first recorded in 1941. It is now amongst the most locally abundant bryophytes in England, to the exclusion of native moss species. Its control is now almost certainly impossible.

10 Amphibian fauna and disease

Chytridiomycosis, a very serious disease of amphibians caused by the fungus *Batrachochytrium dendrobatidis* and first described in 1998, has infected amphibians in many countries. The disease invades amphibian skin, causing mass mortalities in some species whilst leaving others unaffected. Fatalities in sensitive amphibians can reach exceptional levels, and several species are now almost certainly globally extinct because of the disease. We do not know precisely how and in which circumstances the fungus causes disease. It may have only become widespread recently,

England's lost species

- *Kessleria fasciapennella* ■ *Laelia coenosa* (Reed tussock) 1879 ■ *Leucodonta bicoloria* (White prominent) 1880
- *Lithophane furcifera* (The Conformist) 1907 ■ *Lymantria dispar* (Gypsy moth) 1907 ■ *Lyonetia prunifoliella* 1900
- *Margarita sticticalis* (Diamond spot pearl) 1950s ■ *Mesophleps silacella*

perhaps as a result of movement of wildlife or material through human agency. No suitable remedy for wild amphibians is known.

The pathogen was first detected in England's wild amphibians in 2004 and, as of early 2010, 22 populations were found to be infected. Most infections are in common and natterjack toads and smooth newts. Sites are scattered across the country and it is likely that more will be detected. Confirming infection, however, is not the same as confirming disease. Research is currently investigating where there is disease, and the actual effects on infected populations.



The common toad is a familiar sight, but numbers are falling in much of southern England and some colonies have disappeared entirely. The advent of a new disease presents a further threat.

11 Marine fish and overfishing

The world's human population has increased to 6 billion individuals during the 20th century. As some 60 per cent of this population lives within 100 km of a coast, it is not surprising that global fish capture has risen four-fold to about 80 million tonnes per annum.

As a direct consequence, many fish populations are declining. Eighty per cent of commercial fish stocks in the Irish Sea and approximately half of those in the North Sea, Celtic Sea and Western Channel now lie "outside safe biological limits". Two fish species found in English waters are critically endangered, six are endangered and a further 15 are vulnerable to global extinction. Under current conditions, it is likely that we will see further decline in these stocks and national, if not global, extinction for the species concerned. The larger, slow to grow and mature species with low reproductive outputs, like the skates and rays, are of particular concern. Global commercial catches of skates and rays have more than doubled since 1970, with more than 200,000 tonnes caught in 2006. And as nearly 60% of the 3.8 million skates and rays netted annually in English waters is discarded, the impact on the populations is considerably greater than landing records suggest.

We are also concerned about the shift in fishing effort to previously unexploited stocks. For example, as fish stocks in shallow coastal waters decline, fisheries have become established further offshore and in deeper waters. The North Atlantic bottom trawl fishery has sought fish from ever greater depths over the last 50 years, at a rate of some 35 m deeper per decade.



Hove sea anglers with large common skate (centre), and assorted rays in the 1920s. Common skates were once among the most abundant skates in British waters. Due to intensive fishing they are now extinct in much of their English range including the Irish Sea.

England's lost species

■ *Minucia lunaris* (Lunar double-stripe) 1958 ■ *Nola aerugula* (Scarce black arches) 1890 ■ *Nothris verbascella* 1971
■ *Opostega spatulella* 1877 ■ *Oxyptilus pilosellae* 1964 ■ *Pachetra sagittigera* (Feathered ear) 1963 ■ *Paranthrene tabaniformis* (Dusky clearwing) 1924 ■ *Phtheochroa schreibersiana* 1920 ■ *Phyllodesma ilicifolia* (Small lappet) 1965

There is evidence of changes in fish distributions in European waters in response to climate warming. Warm-water red mullet has colonised the North Sea, while cold-water eelpout is retreating northwards. Climate change has also been implicated in low sandeel recruitment in the North Sea, which has not only affected their population size but also led to negative effects on seabird and cetacean species for which sandeels are a major food source. There is an additional concern that fish populations, declining due to aggressive exploitation, will lose genetic diversity and hence be less able to respond to climate change.

12 Species exposed to nutrient enrichment

Nutrient enrichment, or eutrophication, is now recognised as one of the main drivers of biodiversity loss worldwide. The nutrients come from agricultural operations, point sources such as sewage treatment works and diffuse sources such as the combustion of fossil fuels. Freshwaters have been especially affected, as nutrient inputs generally end up in the water courses and standing waters.

Plants that are habitat specialists have particularly suffered, notably grassland and heathland species (such as grass-of-Parnassus and maiden pink) and many freshwater species. Eutrophication in freshwater can also result in siltation, increased phytoplankton growth, reduced oxygen levels and reduced light leading to the total exclusion of submerged plants. Pigmyweed and Esthwaite waterweed are now extinct in England almost certainly as a result of eutrophication, and a larger number of other aquatic species, including whorled water-milfoil, long-stalked pondweed, lesser marshwort and lesser water plantain have also been greatly affected. It is not only the vascular plants that are at risk. Mosses, liverworts and lichens are also exceptionally vulnerable. Many stoneworts, characteristic of low nutrient

freshwaters have been affected, and the slender stonewort is now extinct in England.

Animals too, are affected indirectly by eutrophication, notably as a consequence of increased vegetation growth. For example, this has led to the loss of the bare ground needed by our sun-loving invertebrates and reptiles, particularly on heathlands. Even open-ground nesting birds such as stone curlews are affected. Increased shading from enhanced vegetation growth causes problems for amphibians in ponds and other water bodies. Eutrophication poses the greatest single threat to England's cryptogamic plant communities and many species are likely to be at risk in the next 50 years.



Fen buckler fern, a plant of base-poor fens, the species is now almost entirely confined to the Norfolk Broads and a few nearby coastal wetlands.

England's lost species

- *Pristerognatha penthinana* 1914 ■ *Psamathocrita osseella* ■ *Pyrausta sanguinalis* (Scarce crimson and gold) 1935
- *Scopula immorata* (Lewes wave) 1958 ■ *Scrobipalpa stangei* ■ *Scrobipalpula diffluella* ■ *Scythris fuscoaenea* 1932
- *Sedina buettneri* (Blair's wainscott) 1966 ■ *Sophronia humerella* ■ *Stenoptilia pneumonanthes* 1961



Sand lizard – threatened but recovering

Turning the tide

A small number of species that have become extinct in England now have regular breeding populations again. Their return is either due to natural recolonisation from elsewhere in the UK or continental Europe, or the result of a deliberate and successful re-introduction scheme. There have been two major and successful re-introductions, for the red kite and the large blue butterfly. In addition there are several ongoing re-introduction projects that are in their early stages, including pool frog, corncrake, great bustard and interrupted brome. Although the number of species involved is small and some of these projects still need careful conservation work, they do offer hope that threatened species can once more become established and widespread.

Targeted conservation efforts over the past 15 years have also improved the status of a significant number of the priority species that appeared on the original BAP list. The latest assessment in 2008 reported that some 45

species (12%) were increasing, 128 (33%) were now stable and for a further 22 (6%) the decline in England was slowing.

Bittern numbers, for example, increased from 19 booming males in 1999 to 75 in 2008 (at a similar level to the 20th century peak in the mid-1950s). A major programme of reedbed restoration and creation has fuelled this increase – and had benefits for other reedbed species. Similar efforts to conserve lowland heathland and chalk grassland have undoubtedly assisted the recovery of a number of species, including the woodlark, sand lizard, early gentian, ladybird spider, and Adonis blue and silver-studded blue butterflies. Largely as a result of this conservation effort, a number of BAP species, including the pipistrelle bat, silver-spotted skipper, pink meadow cap, slender green feather-moss, western ramping-fumitory and Killarney fern were not re-selected for inclusion in the revised BAP list in 2007 because their conservation targets had been met.

England's lost species

■ *Stenoptinea cyaneimarmorella* 1944 ■ *Stigmella tormalis* 1800s ■ *Syncopacma vinella* ■ *Tenaga nigripunctella* 1934
■ *Thetidia smaragdaria maritime* (Essex emerald) 1991 ■ *Tischeria gaunacella* 1800s ■ *Trachea atriplicis* (Orache) 1905 ■
Trigonophora flammea (Flame brocade) 1892 ■ *Ypsolopha asperella* 1886

Trends in UK priority species in 2008

Increasing trends were reported for 45 species, including:

otter, water vole, greater and lesser horseshoe bats, cirl bunting, stone curlew, nightjar, woodlark, sand lizard, pool frog, ladybird spider, Adonis blue and large blue butterflies, black-veined moth, field cricket, brown-banded carder bumblebee, stinking hawk's beard and holly-leaved naiad.

Stable trends were reported for 128 species, including:

tree sparrow, bullfinch, basking shark, fen raft spider, southern damselfly, wart-biter cricket, Purbeck mason wasp, bog hoverfly, pink sea-fan, starlet sea anemone, lady's slipper orchid, shore dock, early gentian, wild asparagus, nail fungus, oak polypore and bearded tooth fungi, petalwort, Cornish path moss and triangular pygmy-moss.

Slowing declines were reported for 22 species, including:

dormouse, grey partridge, great crested newt, marsh and high brown fritillaries, silver-studded blue, narrow-bordered bee hawk-moth, hornet robberfly, straw belle, marsh moth and broad-leaved cudweed.

The polecat – a weasel's return

The polecat is a medium-sized member of the weasel family that once occurred throughout England. As a predator with a well-known penchant for attacking chickens, it was subject to human persecution from early times, but it remained fairly widespread and common until at least 1800. The Enclosure Acts and subsequent development of the gamekeepered sporting estate led to the polecat's virtual disappearance from England by the beginning of the First World War. This disappearance was noted first in the southern counties of England but proceeded rapidly, so that within less than 100 years the species' British range had retreated to Wales and the Welsh Marches. It remained confined to these areas for the next 30 years. A relaxation of gamekeeping pressure, beginning in the Second World War, has since allowed the species to reclaim much of its former range. The most recent survey shows the species spreading right across the Midlands and southern England, with a significant outlying



Polecat – recolonising

population in Cumbria and Lancashire. This range expansion is predicted to continue, but it may be affected by the barrier effect of large conurbations, such as the Liverpool-Manchester area.

England's lost species

Sawflies ■ *Cimbex quadrimaculatus* 1800s ■ *Cladardis elongatula* 1800s ■ *Corynis crassicornis* early-1800s ■ *Corynis obscura* early-1800s ■ *Megalodontes cephalotes* early-1800s ■ *Pseudoclavellaria amerinae* 1800s ■ *Strongylogaster filicis* 1873 **Shrimps** ■ *Artemia salina* (Brine shrimp) 1907 **Snails** ■ *Braybaena fruticum* c1950

The bearded stonewort – finding a new home

Stoneworts are a group of large complex algae that grow submerged in fresh and brackish water. A likeness to vascular plants has encouraged botanists to study them, so our knowledge of their distribution is better than that of other freshwater algae. They are generally associated with water with a low nutrient concentration, because they are out-competed by other aquatic plant species in waters with higher nutrient loadings. The bearded stonewort is a brackish water species that used to occur in coastal sites of high alkalinity, including Swan Pool and Little Sea in Dorset, Easton and Benacre Broads in Suffolk, and Hickling Broad in Norfolk.

Changes in salinity from natural coastal processes and increased nutrient

enrichment from agriculture and sewage probably resulted in its decline. By the 1980s it was thought to be extinct in England and known in just three lochs in the Western Isles, Scotland. In 1989, it was re-discovered in a new inland site near Peterborough. The plant had colonised some recently abandoned brick clay pits where the unusual chemistry of the clay seems to have mimicked coastal conditions. It has since been re-introduced to pools in the vicinity of its original coastal sites but the Peterborough brick pits remain its stronghold.

The Orton Pit supports an additional nine species and is the richest single site for stoneworts in Britain.



England's lost species

■ *Myxas glutinosa* (Glutinous snail) 1991 ■ **Spiders** ■ *Diploia coracina* 1913 ■ *Gibbaranea bituberculata* 1954
■ *Hypsosinga heri* 1912 ■ *Mastigusa arietina* 1926 ■ **Stoneflies** ■ *Brachyptera putata* 2000s ■ *Isogenus nubecula* 2000s
■ *Isoperla obscura* 1920 ■ *Xanthoperla* (*Chloroperla*) *apicalis* 1850

The pool frog – first return of a lost vertebrate

The native status of pool frogs in England was debated as far back as the middle of the 19th century. This was partly because similar frogs were known to have been introduced from continental Europe. Research in the late 1990s examined pool frog mating calls, genetics, fossil bones and the literature record, and confirmed that pool frogs should be considered native to East Anglia. English pool frogs were also part of a distinct – and now very rare – northern group, comprising pool frogs in England, Norway and Sweden. The research showed that pool frog calls have regional “accents”, and genetic studies revealed that this is consistent with their ancestry. Pool frogs in central and southern Europe are a separate group, and much less of a conservation concern.

Pool frog populations in England declined dramatically following fenland drainage – a fate shared with the large copper butterfly, bittern and many other animals and plants. This was compounded by loss of grazing, habitat destruction and, latterly, collection. The last native population – at Thompson Common, in Norfolk – was lost in the mid-1990s. Re-introduction to a carefully prepared Norfolk site took place during 2005-2008, using pool frogs collected in Sweden under special permission.

The early signs of success are encouraging and the frogs have bred successfully. Other species have also benefited from the habitat restoration work. The pool frog is the only example to date of a British extinct vertebrate being returned through planned re-introduction.



Pool frog – re-introduced

England's lost species

Stoneworts ■ *Nitella capillaries* (Slimy-fruited stonewort) 1959 ■ *Nitella gracilis* (Slender stonewort) 1914 ■ *Nitella hyaline* (Many-branched stonewort) 1915 ■ *Tolypella nidifica* (Bird's nest stonewort) 1956 **True bugs** ■ *Trioza proxima* 1876 ■ *Cicadetta montana* (New Forest cicada) 1988 **Vascular plants** ■ *Asplenium fontanum* (Rock spleenwort)

The red kite – a re-introduction success story

Once a common scavenger, even abundant in our largest cities, the red kite was lost from England by the close of the 19th century. The birds were relentlessly persecuted for supposedly preying on livestock, with campaigns against them fuelled by the offer of bounties. Persecution intensified with the advent of game-shooting in the late 18th century and, as they became rare, kite skins, nests and eggs became highly prized, accelerating their decline. The birds had all disappeared from England by about 1870, although migrants occurred with some regularity and some wandered from neighbouring Wales.

Breeding populations have now been established in several areas of England through a major re-introduction programme. The first phase involved the release of 93 birds (mainly from Spain) in the Chilterns between 1989 and 1994, and by 2000 there were 112 breeding pairs in the area. Subsequent releases (of kites from the burgeoning Chilterns population) have taken place in Rockingham Forest, Northamptonshire, on the Harewood Estate

in Yorkshire and most recently in Gateshead, County Durham. It is now impossible for fieldworkers to locate all nesting pairs, but surveys conducted in 2009 put the English population at some 800 pairs.

The kites are a considerable draw for tourists, both on their breeding grounds but especially in the vicinity of their winter roosts, where over a hundred birds often gather, performing spectacular aerial displays. Illegal killing, both deliberately and through misuse of rodenticides or poisoned bait intended for other species, has led to many deaths. This has not prevented populations in England from increasing, but has undoubtedly slowed the rate with which new areas are colonised. Red kites are generalist scavengers, frequenting open country in both upland and lowland situations and nesting in woodland, so the potential for further expansion of range and numbers is significant. The success of the re-introduction project is widely regarded as one of the greatest success stories of wildlife conservation in the late 20th century.



Red kite – re-introduced. Release of young red kites in Northamptonshire, mid 1990s.

England's lost species

■ *Carex davalliana* (Davall's sedge) 1831 ■ *Carex trinervis* (Three-nerved sedge) 1869 ■ *Centaureum scilloides* (Perennial centaury) c1967 ■ *Crassula aquatica* (Pygmyweed) c1945 ■ *Cystopteris alpina* (Alpine bladder-fern) 1911 ■ *Cystopteris montana* (Mountain bladder-fern) 1880 ■ *Euphorbia peplis* (Purple spurge) 1951 ■ *Hydrilla verticillata* (Esthwaite waterweed) 1955



Leatherback turtle – globally threatened

Conclusions and priorities for action

Many species have been lost from England, and at regional level the losses are even more dramatic. We have documented the loss of 492 species from England, the vast majority of these being since 1800, and even this is likely to be an underestimate. These losses matter and most were caused by people either as a consequence of the changes we have made to natural habitats or, in some cases, deliberately. Species have their own intrinsic value, and to over-exploit or damage our environment in ways that lead to their loss is simply wrong and a failure in our duty of care for nature. Species losses also matter because they reflect wider declines in the quality of England's natural environment, on which we depend for our health and wellbeing. We are only just

beginning to understand the economic and social consequences of these losses, but the evidence is mounting that they are enormous. The cost of global biodiversity loss by 2050, for example, is estimated to be as much as €14 trillion (7 per cent of global GDP).

A significant number of England's remaining species are under threat and, in order to prevent further loss, we must reverse past and current declines. We still have a considerable wealth of biodiversity in our countryside, towns and seas but, with so many species in decline or at very low numbers, we must take more action, now. The successes that we have already achieved, such as progress with the recovery of the otter, reed bunting,

England's lost species

■ *Linnaea borealis* (Twinflower) ■ *Melampyrum sylvaticum* (Small cow-wheat) late-1900s ■ *Najas flexilis* (Slender naiad) 1982
■ *Otanthus maritimus* (Cottonweed) 1936 ■ *Polygonatum verticillatum* (Whorled Solomon's-seal) 1866 ■ *Ranunculus reptans* (Creeping spearwort) ■ *Scheuchzeria palustris* (Rannoch rush) c1900

ladybird spider and other species show what can be achieved. In a limited number of situations, re-introductions of lost species will be an appropriate conservation response. The successful re-introductions of species such as the large blue butterfly and red kite demonstrate the value of this approach.

Targeted species recovery projects are valuable but they will not be enough. It is now widely accepted that the 2010 target to halt biodiversity loss will not be met. We need to address the challenges of species decline and loss on a broader front, taking measures that address how we use and protect the natural environment as a whole. The challenge is made greater by climate change, but we believe that additional, concerted action can succeed in halting and ultimately reversing many of the current declines in biodiversity. In England, we consider the top priorities for further action to be to:

Better protect and manage the remaining wildlife habitats

Much of the habitat needed by wildlife has been lost – for example, 97% of species-rich grasslands have been lost since the 1930s. The wildlife habitat that we have left is precious and needs to be protected. Some sites are afforded legal protection, such as those designated Sites of Special Scientific Interest (SSSIs), and management of these is steadily improving. There are, however, many other sites important for species in our towns and countryside and many of these are deteriorating or at risk of being destroyed completely. We need to protect these sites better, such as through the planning system, and ensure they are managed to support the species that depend on them.

Restore and create additional high-value wildlife habitat, including through enhancements at a landscape scale

Habitat loss has been the major driver of species losses, and many species are now restricted to a few remaining refuges. Of our BAP priority species, 412 are known from fewer than five sites. To enable species populations to recover to self-sustaining levels, we need to expand the amount of habitat that is available to them in our countryside and towns. In the short term, our priority should be to meet our BAP habitat expansion and restoration targets. In the medium to long term we need to establish a more resilient and better connected ecological network. This needs to include enhancement programmes for biodiversity across whole landscapes to restore ecological processes, increase connectivity and facilitate dispersal. This will be particularly important to enable species to move as our climate changes. In this regard, we welcome the independent review of England's wildlife sites and ecological network that has been commissioned by the Secretary of State for Environment, Food and Rural Affairs.

Establish a coherent network of Marine Protected Areas

The rich biodiversity in our seas is under threat in the face of multiple and increasing pressures and requires more and better protection. The Marine & Coastal Access Act (2009) includes provision for a network of Marine Protected Areas (MPAs). This needs to be established and should be ecologically coherent, well-managed, protect a representative selection of both habitats and species, and increase the proportion of our seas that is protected.

England's lost species

■ *Senecio eboracensis* (York groundsel) 2000 ■ *Spiranthes aestivalis* (Summer lady's-tresses) 1950s ■ *Spiranthes romanzoffiana* (Irish lady's-tresses) 1990s ■ *Tephrosia palustris* (Marsh fleawort) 1947 ■ **Wasps** ■ *Arachnospila rufa* 1938 ■ *Cerceris sabulosa* 1861 ■ *Dinetus pictus* 1880 ■ *Hedychrum rutians* 1899 ■ *Lestica clypeata* 1853 ■ *Mellinus crabroneus* 1952

Establish more sustainable practices for all our land and seas

Many of our remaining species will not survive if they become restricted to protected areas – they need to be able to live in and move through our countryside or through our seas, particularly as our climate changes.

We believe it is possible to achieve thriving farming, forestry and fishery industries in England without over-exploiting or damaging our natural environment. The National Farmers' Union's Campaign for the Farmed Environment is an example of the kind of industry-led initiative that can help achieve more sustainable practices.

Reduce the impact of invasive non-native species

A small but significant minority of non-native species have caused considerable harm to our wildlife. This proportion may increase with climate change. We need to prevent new invasive non-native species becoming established in England, adopting a risk-based precautionary approach, as set out in the Invasive Non-native Species Framework Strategy for Great Britain. We also need to manage populations of existing invasive non-native species, such as American bull frog and Japanese knotweed to reduce their impact.

Take further steps to reduce illegal killing and collecting of our native species

The law affords protection to certain species to prevent them being killed (such as birds) or collected (certain plants). These laws need to be complied with and enforced. Bodies such as the Partnership for Action against Wildlife Crime provide opportunities for statutory and non-Government organisations to work together and take co-ordinated action.

The challenges before us are significant if we are to halt and then reverse the pattern of human-induced loss documented in this report. Meeting them will require concerted action from all sectors of society and this is only likely if the value of biodiversity, and the goods and services it provides, is better taken into account in decisions that impact upon the natural environment. We believe it is unrealistic to seek restoration of all our lost biodiversity. Rather, we need to work together to build a healthy natural environment for the future with functioning ecological processes, in which England's species can thrive and reach new self-sustaining levels. In doing so, we will also enhance the ability of our natural environment to provide the services that enhance our wealth, health and wellbeing. Consequently, the action we take today to provide a better future for England's remaining species will also provide a better future for us all.

England's lost species

■ *Mellinus sabulosa* 1952 ■ *Odynerus reniformis* 1922 ■ *Orussus abietinus* c1820 ■ *Priocnemis propinqua* 1899 ■ *Psen ater* 1850 ■ *Tachysphex obscuripennis* 1882 **Water beetles** ■ *Graphoderus bilineatus* 1906 ■ *Gyrinus natator* 1921 ■ *Ochthebius aeneus* 1913 ■ *Rhantus aberratus* 1904 ■ *Spercheus emarginatus* 1956

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		Pg 49:	NHPA/Michael Patrick

Front cover photograph: Pine martens are one of England's rarest mammals. A survey is now underway to track their presence across northern parts of the country.



Natural England is here to conserve and enhance the natural environment, for its intrinsic value, the wellbeing and enjoyment of people and the economic prosperity that it brings.

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