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 hawker 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* ■ *Euclemensia 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 torminalis* 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 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.


Polecat – recolonising

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** ■ *Dipoena 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 ■ *Centaurium 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 ■ *Tephroseris palustris* (Marsh fleawort) 1947 **Wasps** ■ *Arachnospila rufa* 1938 ■ *Cerceris sabulosa* 1861 ■ *Dinetus pictus* 1880 ■ *Hedychrum rutlians* 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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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.

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