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# Bitterns and Bittern Conservation in the UK

Andy Brown, Gillian Gilbert and Simon Wotton



Ben Green

**Abstract** Once widespread and even locally numerous across the lowlands of the UK, the Eurasian Bittern *Botaurus stellaris* had been extirpated by a combination of habitat loss and persecution by the late 1880s. After the species returned, at the start of the second decade of the twentieth century, numbers increased to a peak in the 1950s, before falling precipitously to a low point in 1997, when the population was only just into double figures. Extinction – for a second time – was averted only by a concerted conservation effort to restore the larger reedbeds which still contained Bitterns and those from which the birds had most recently been lost. A programme to create extensive new reedbeds also began at this time, with both efforts supported by detailed research, which identified the key factors affecting reedbed use by Bitterns. To date, Bittern numbers have responded well, though work continues to refine our knowledge and to identify the benefits to other wildlife of management aimed at further increasing Bittern numbers and productivity. But the future of Bitterns in the UK is far from secure, with climate change, through sea-level rise and drying in the southeast, threatening to undermine much that has been achieved. A reinvigorated reedbed creation programme is now underway, which should provide a secure future for Bitterns in the UK. This paper tells the full story of Bitterns and of the Bittern conservation effort in the UK.

### Bittern distribution and numbers prior to national extinction

The Eurasian Bittern *Botaurus stellaris* (hereafter 'Bittern') is widespread across Europe, central and southern Asia and North Africa. It is nowhere numerous, being almost wholly confined to a scarce, fragmented and declining habitat – large freshwater wetlands, usually, but not exclusively, dominated by stands of Common Reed *Phragmites australis*. Regarded as Vulnerable in Europe following decades of population decline (BirdLife International 2004), the species is a Red-listed bird of UK conservation concern and a UK BAP Priority Species.

The Bittern has long been known as an inhabitant of the UK. Much superstition, mystery and even fear has surrounded the bird – not least because the low-frequency 'booming' song of the male is such an unusual, eerie sound, not obviously produced by a bird. The Irish writer Oliver Goldsmith remarked that 'those who have walked in an evening by the sedgy sides of unfrequented rivers, must remember the variety of notes from different water-fowl: the loud scream of the wild-geese, the croaking of the mallard, the whining of the lapwing, and the tremulous neighing of the jack-snipe. But of all those sounds, there is none so dismally hollow as the booming of the bittern. It is impossible for words to give those who have not heard this evening call an adequate idea of its solemnity... issuing from some formidable being that resided at the bottom of the waters.' He went on: 'I remember, in the place where I was a boy, with what terror this bird's note affected the whole village; they considered it the presage of some sad event; and generally found or made one to succeed it. I do not speak ludicrously; but if any person in the neighbourhood died, they supposed it could not be otherwise, for the night-raven had foretold it; but if no body happened to die, the death of a cow or a sheep gave completion to the prophecy' (Goldsmith 1851).

Even today, few can claim to have *seen* a Bittern boom so it is understandable that many misconceptions have arisen as to how the sound is produced. Isaac Casaubon, a visitor to Ely in Cambridgeshire in 1611 and quoted in Lack (1934), stated that 'In the Ely

country there is a bird about as big as a hen, in colour a mixture of yellow and grey, etc., having very long legs, and called Blitterra. It is said to be in the habit of introducing its bill into one of the nearest reeds, and of thundering forth a voice so horrible that those unused to the thing, say it is that of an evil spirit, and so loud that two gentlemen assured me it could be heard for three or four miles. It is not agreeable meat.' Goldsmith, however, had a remarkably correct understanding, stating that 'its windpipe is fitted to produce the sound for which it is remarkable; the lower part of it dividing into the lungs, is supplied with a thin loose membrane, that can be filled with a large body of air, and exploded at pleasure. These bellowing explosions are chiefly heard from the beginning of spring to the end of autumn; and however awful they may sound to us, are the calls to courtship, or of connubial felicity.'

Once widespread across the lowlands of the UK, the Bittern had many local names – among them bog blutter, buttle, bumbagus, myre-dromble, miredrum, bog-bluitter and butterbump – and these suggest a familiarity to country dwellers in many areas. Evidence of local abundance comes from some of the earliest ornithological literature. For example, Lubbock (1845) wrote that: 'I remember when the birds could be found with certainty in the extensive tracts of reed about Hickling broad and Heigham sounds [in Norfolk]. Four or five might be seen in a morning.' Stevenson (1870) reported that a thatcher at Feltwell in the Norfolk fens had told him that Bitterns were once 'extremely plentiful' in that neighbourhood, selling for the same price as Common Snipe *Gallinago gallinago*. The thatcher told Stevenson that his gamekeeper grandfather had a Bittern roasted for dinner every Sunday and had once shot five birds in one day in the nearby fens. Stevenson (1870) himself reported a tally of 108 Bitterns killed in Norfolk between October and April in the 18 years prior to the writing of his book.

Unfortunately, the literature contains few reports of confirmed breeding and it is often not clear whether the reports of large numbers refer to the breeding or winter season. However, given the difficulty of finding Bittern nests, it would be unwise to



**37.** A Eurasian Bittern *Botaurus stellaris* in characteristic hunting pose: some modern-day, well-placed hides now regularly permit such encounters; Norfolk, February 2008.

infer from the paucity of confirmed breeding records that Bitterns were only ever numerous in winter. It is, nevertheless, rather difficult to determine the distribution, let alone numbers, of breeding Bitterns in the UK prior to national extinction in about 1886. However, it is evident that Bitterns once bred in all the constituent countries of the UK. In Scotland, it was a fairly common resident breeding species, one of the birds preserved for the sport of hawking and mentioned in several fifteenth- and sixteenth-century texts (Baxter & Rintoul 1953). Testament to its former abundance in Scotland is the comment in Montagu (1831) that 'the sound of the Bittern is so very common that every child is familiar with it, though the birds, from being shy, are not often seen'; although by the time he wrote that passage, the Bittern was breeding regularly in only a very few places in Scotland. In Ireland, the Bittern had also once been regarded as common. Thompson (1850) wrote that: 'once common in Ireland, [the Bittern] is gradually becoming scarce, owing to the drainage of the bogs and marshes.' He added that: 'it therefore seems desirable to me, in a statistical point of view, that such information that I possess on the species should be given in

detail.' However, he was able to report only the recollections of others that birds boomed in Northern Ireland 'in the neighbourhood of Dungiven' in Co. Londonderry and in Co. Fermanagh about 1820 and that the birds were common in the Lower Ardes, Co. Down, in about 1744. His other records, all from the winter period, were of a single bird from Co. Armagh, three from Co. Antrim and perhaps 15 or so from Co. Down, including 'about six' obtained some 10–12 years prior to 1833, three from within five miles [8 km] of Belfast (Thompson 1850). It is believed that Bitterns have not bred in Northern Ireland (nor elsewhere in Ireland) since the 1840s (Ussher & Warren 1900; Rutledge 1966; Allen & Mellon 2010). In Wales, the species was also once widespread but had become restricted to Margam and Crymlyn in Glamorgan, Cors Caron and Cors Fochno in Ceredigion and probably also Anglesey by the middle of the nineteenth century (Lovegrove *et al.* 1994).

There is rather more information concerning the former distribution of Bitterns in England, even though here, as elsewhere, much of the species' wetland habitat had already been drained by the time the early Victorian avifaunas were being compiled and

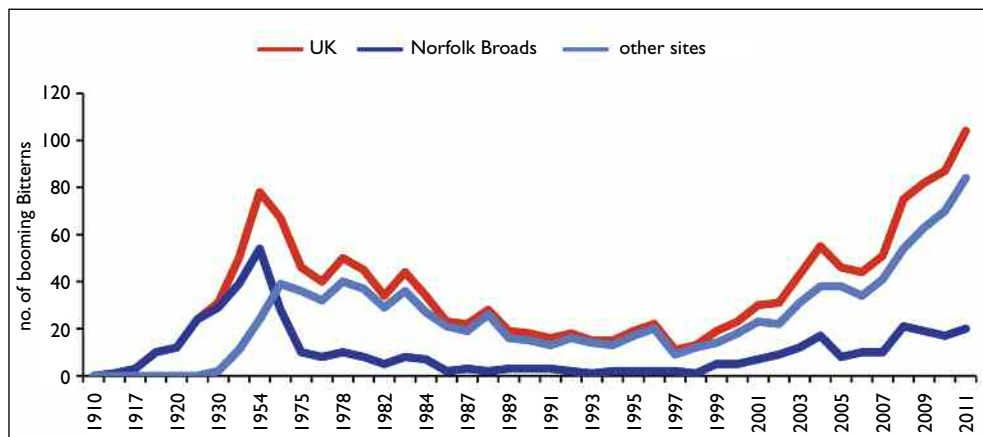
much had been lost altogether by the late Victorian period. Perhaps understandably, much of the available information is rather vague, concerns purported last records (often of 'boomers' found long after regular breeding ceased in an area), or approximations of when breeding ceased in a county. Nevertheless, it is evident that they once bred from Kent and Somerset in the south, locally northwards to both Cumbria and Northumberland. Their demise from many counties has apparently gone undocumented but in Cheshire nests were known until the early part of the nineteenth century, in Northumberland until about 1820 (at Newham), in Cambridgeshire until 1821, in Shropshire until 1836, in Lincolnshire until about 1850 (birds being still reportedly numerous in the Isle of Axholme in the 1830s), in Warwickshire until about 1865, in Suffolk probably until the 1870s, in Dorset until 1883, in Hampshire until sometime between 1886 and 1889 (in Avington Park, near Winchester) and in Cumbria possibly until as late as 1891 (Holloway 1996; Green 2004; Lorand & Atkin 1989; SOS 1992). The last confirmed breeding records for the UK came from Norfolk, where booming birds were present in the Hoveton/Woodbastwick area in 1866 (where Stevenson described clearly what appears to have been a feeding flight in June of that year) and again in 1867, two eggs were taken from a nest on Upton Broad in 1868, a downy young bird was taken alive on 25th

May from the same area in the same year and a downy female was found near Ludham in 1886 (Stevenson 1866–90).

The cause of the species' loss is far from obscure. Many of their reedbed haunts were drained (the process of drainage began in earnest in the seventeenth century) and the land put to agricultural use, while others were left as small fragments in an otherwise hostile landscape. Macpherson (1892), for example, reported that in Lakeland: 'if a stray Bittern lingered among our bogs and flows during the early summers of the present century, the energy of the engineers who converted pools of standing water into valuable corn-fields, soon banished the poor "Miredrum" from the ancient home of its race.' Even where the habitat allowed them to persist, as in Broadland, they were much persecuted by skin collectors, eggers, sportsmen and by those seeking the species' flesh for the table.

## Bitterns return, increase in numbers then decline again

Rather against the odds, Bitterns boomed again, reportedly at Cardew Mire in Cumbria in 1891 (Macpherson 1892) and certainly in Broadland in 1900 but it was not until 1911 that evidence of breeding was found when young birds and a vacated nest were discovered at Sutton Broad in Norfolk. Perhaps heeding the warning of Broadland Bittern-protector Emma Turner (1919) that 'it will



**Fig. 1.** The numbers of booming male Eurasian Bitterns *Botaurus stellaris* in the UK, 1910–2011. The figures up to 1989 are estimates made irregularly from the available literature. Those from 1990 are derived from standardised annual monitoring. The UK total is split into birds in the Norfolk Broads and those elsewhere. Note non-regular intervals for years to 1987 and annual intervals thereafter.



now be the duty of every ornithologist... to guard this recovered inheritance which our forefathers wasted so shockingly', Bitterns were left relatively unmolested, and numbers gradually increased in Broadland, reaching an estimated 16–17 'pairs' by 1923 (Turner 1924, who found 11 nests that year) and some 23–25 'pairs' by 1928 (Riviere 1930).

Breeding was confirmed for the first time away from Broadland, at Thorpeness in Suffolk, in 1929. Within the decade, confirmation also came from Cley in north Norfolk in 1937 and from Burwell Fen in Cambridgeshire in 1938 (but not subsequently in the county until decades later) and by the end of the 1930s, booming birds had been reported from widely spread localities across Britain and Ireland. Booming was first reported in Kent in 1935 or 1938, at Leighton Moss in Lancashire in 1937 and breeding attempts were reported from Ayrshire and Fife (Forrester *et al.* 2007) and Co. Offaly some time before 1940 (Ruttledge 1966). Breeding was first confirmed in Essex in 1944, in Kent in 1947 (Stodmarsh), in Lincolnshire in 1949, in Northumberland in 1956, in Lancashire in 1958 (Leighton Moss) and on Anglesey in 1968 (Llyn Traffwll) (Payn 1962; Day & Wilson 1978; Taylor *et al.* 1981; Lorand & Atkin 1989; Wood 2007).

The British population reached a peak of some 79–82 booming males in 1954 (Day & Wilson 1978), this increase having no doubt been facilitated by the flooding of a significant area of low-lying coastal land during World War II and its subsequent abandonment and colonisation by reed.

Despite the increase in both range and numbers, 98% of the birds in 1954 were still to be found in England; even there, though spread over seven counties, 74–75 boomers were found in just two counties – Norfolk and Suffolk – where the great majority were still to be found in Broadland. This important area no doubt controlled proceedings farther afield, producing many young Bitterns that were able to colonise other areas. However, these areas then lost their birds a few years later at the same time as the Broadland population began to decline seriously (fig. 1). The 1970 national survey revealed that numbers of booming birds in Broadland had fallen by 48%, from 54 boomers in 1954 to just 28 in 1970. A national survey in 1976 revealed just 45–47 boomers nationwide (Day & Wilson 1978), with 21–22 in Suffolk, ten in both Norfolk (where just nine were in Broadland) and Lancashire, two in North Wales and one or two in Somerset and Lincolnshire. Birds were lost altogether from the Somerset Levels,



Robin Chittenden

38. Eurasian Bittern *Botaurus stellaris*, Strumpshaw Fen, Norfolk, November 2010.

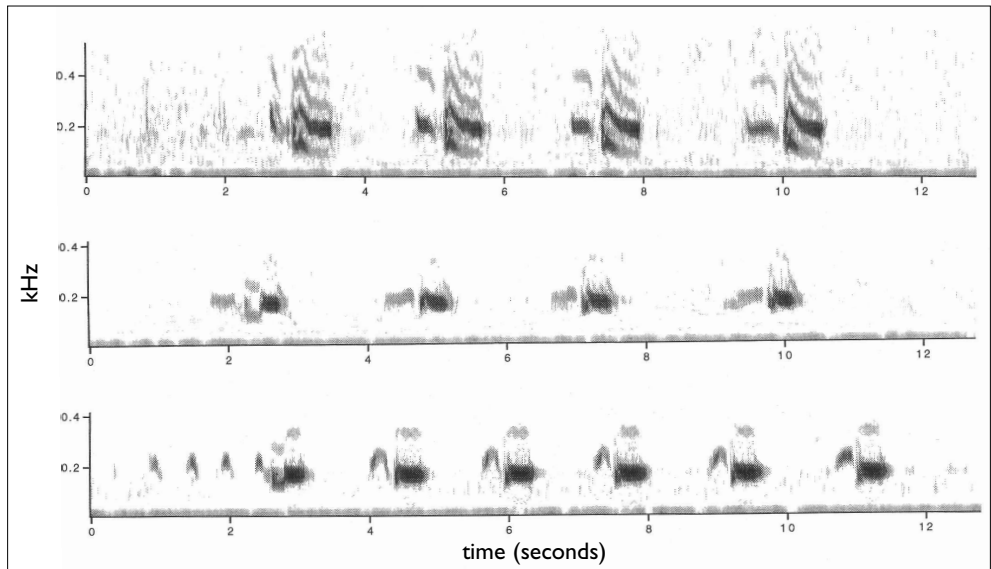
the Stour Valley of Kent and the Humber Bank between the 1968–72 and the 1988–91 atlases, and by the late 1980s booming birds were virtually confined to Leighton Moss in Lancashire, to the Hickling, Horsey and Martham area of Norfolk's Broadland, to the north Norfolk coast (principally at Cley but irregularly elsewhere), and to the Suffolk coast at Minsmere, Walberswick and at Easton, Covehithe and Benacre Broads.

Outside England, booming Bitterns had by this time become really exceptional finds. For example, 85% of sightings in Scotland since 1950 were made during the autumn and winter months, with about a dozen records of summering birds, including a bird which boomed in the Borders in 1980 (Thom 1986). There is no evidence that any of these birds ever bred in the country (Forrester *et al.* 2007). In Wales, a small population of booming birds built up on Anglesey following colonisation in the late 1960s, with booming birds at five sites on the island in 1966 and up to 11 boomers present annually in the mid 1970s. The favoured sites were the wetlands at Llyn Llywenan, Penrhyn, Dinam, Garreg-lwyd, Tarffwll, Maelog, Bodgylched, Padrig and Coron but breeding was proved only in 1968; numbers fell rapidly during the 1970s and

breeding activity had ceased by the mid 1980s. Elsewhere in Wales, booming birds were present on the Gower at Oxwich annually during 1969–74, with two boomers present in spring 1972. A 'pair' was reported there in 1973 and another bird boomed in 1979. There were only 19 or 20 occurrences of Bitterns in Northern Ireland in the twentieth century and most of those were wintering birds, found in every county with the exception of Tyrone. There were, however, three records of birds in the summer months: two birds were at Killough, Co. Down, on 23rd July 1953 and there are two records of booming birds at Lough Erne, Co. Fermanagh, in 1976, though these perhaps involved the same individual (Allen & Mellon 2010).



Guy Shorrock



Gillian Gilbert

**39.** Understanding Eurasian Bittern *Botaurus stellaris* ecology necessitated the adoption of some new approaches. Sound recordings and sonogram analyses (here of three different individuals at Minsmere, Suffolk, in 1997) demonstrated that booming males each had unique calls and this information has been used to obtain more accurate population estimates.

By the 1980s, it was clearly an urgent matter to determine accurately the number of individuals at the few sites that still retained Bitterns and to work out why other sites had lost them. A national survey in 1990 used a new method that combined techniques of mapping the territories of booming male Bitterns using triangulation and the individual identification of these males by the characteristics of their booming songs. Annual monitoring has taken place since 1990 at a national scale, enabling us to measure change, to prioritise the allocation of resources, to attract funding, set targets and to measure the effectiveness of our actions (the habitat management necessary to rehabilitate reedbeds and to create others from scratch is expensive and it has been essential to measure how the population has reacted to that expenditure). Later research led to a standardised programme of monitoring, not only of vocalising males, but also of nesting females, prey availability, water quality and habitat. This has helped diagnose site-specific problems and allowed us to further target habitat management. The 1990 survey revealed a shockingly low UK popula-

tion of just 18–20 booming males, all in England. Worse was to come, and by 1997 the population stood at just 11 boomers at seven English sites (Wotton *et al.* 2011).

Throughout that time, Bittern numbers have apparently remained buoyant in winter, with English-bred birds joined by an annual arrival of continental immigrants. Bibby (1981) estimated that 30–100 were probably to be found in Britain in most years, but during the hard winter of 1978/79 a total of 189 were located (Bibby 1981) and, indeed, the severity of winter weather on the continent does seem to determine numbers appearing here (Bibby 1981). Though widespread in winter, most birds were, and continue to be, found in southern and southeastern reedbeds, from Norfolk to Dorset. At this time of year, Bitterns may be found in smaller reedbeds, including those around small lakes, ponds and gravel-pits, along ditches on grazing marshes or in other wetlands at sewage treatment works and watercress beds. Despite the buoyant winter numbers, most if not all immigrants returned to the continent in spring and breeding numbers continued an inexorable decline.



Robin Chittenden

**40.** Freezing conditions tend to cause Eurasian Bitterns *Botaurus stellaris* to move out of the reedy shallows in order to hunt, and opportunities for observing Bitterns have most often been provided when such conditions prevail; Norfolk, December 2010.



## Diagnosing the causes of decline

The extremely worrying results of the annual monitoring programme in the early 1990s were the catalyst to begin a period of intensive research, designed to help diagnose the causes of decline and to identify a means of halting and then reversing it. This is a rare species, almost impossible to observe, inhabiting an unwelcoming habitat that is difficult to access; perhaps unsurprisingly, then, there had been no previous research into its habits in any part of its range. The initial approach in the UK was thus a cautious one.

The first step was to compare the habitat characteristics of 11 reedbeds that had been abandoned by Bitterns over a 12-year period with the same characteristics from 11 that had retained them. Detailed measures, reflecting the successional stage of the habitat (e.g. litter build up, basal vegetation density, water levels and the degree of scrub encroachment), were taken from randomly located quadrats within each site. These measures were then related statistically to the presence or absence of Bitterns, the results giving the first quantitative evidence that seral succession and inappropriate management of our freshwater vegetative communities was limiting Bittern populations (Tyler *et al.* 1998). Habitat degradation – essentially drying – leading to a lack of suitable places for Bitterns to forage and to nest was considered to be of primary importance in driving the loss of Bitterns.

Further evidence of the importance of water levels came from an analysis of the between-year survival of individual adult male Bitterns. Local annual survival was positively related to rainfall in winter (January to March), indicating that rainfall, through its effect on water levels, was an important influence on survival or the likelihood of

permanent emigration (Gilbert *et al.* 2002).

It was clear that the small number of Bitterns that remained in the UK in the early 1990s occupied the larger, wetter sites that had been managed in some way, sometimes for commercial reed-cutting purposes. Smaller, dry and tidal reedbeds were apparently avoided. By the mid 1990s, it was also evident that most of the UK's reedbeds were, in fact, too small and too dry. Even where a reedbed might be regarded as wet and where it still held breeding Bitterns, it often contained extensive stands of dry reed, unsuited to use by Bitterns. The unpalatable fact is that favoured Bittern habitat tends to be transient, gradually lost as reed litter accumulates and as the reedbeds become drier. Scrub can then encroach and dry the reedbed more rapidly still – so that it eventually becomes first carr, then dry woodland. This process of natural seral succession had clearly been the principal cause of the species' decline since the 1950s.

This initial insight provided a huge leap forward in our knowledge of Bittern ecology at a site scale. But our understanding quickly developed further as more detailed studies of habitat selection, diet and the breeding biology of individual birds were conducted, often using new techniques. The study of the males' booming behaviour and their use of a breeding home range, for example, allowed us to define a measurable area of importance



Andy Brown

**41.** A party of researchers trying to locate the first Eurasian Bittern *Botaurus stellaris* nest for many decades on the banks of the Humber in 2000. Note the tall stick – an essential aid to mapping nest locations before the advent of affordable GPS!

for individual birds. During the breeding season, the males feed within these home ranges and the selection of habitat within them is driven by the availability of food. The males' more obvious and predictable behaviour makes them easier to catch than females and several individuals were fitted with radio transmitters. Radio-tagging and the time-consuming process of mapping the locations of, and sound recording, individual booming males (see Box 1), gave an important insight into the behaviour of territorial males, espe-

cially the finding that they preferred the flooded 30-m margin of vegetation next to open water (Gilbert *et al.* 2005). Triangulation and radio-tracking studies from across Europe revealed a common pattern, with the presence of tall, emergent vegetation and standing water, especially open water, being of prime importance to Bitterns. The relative composition of these elements was found to differ according to the needs of the most readily available prey species. The crucial insight concerned the importance of the

### 'Bittern pioneers'.

### BOX 1

Necessity is the mother of invention and during the campaign to take recovery action for such a difficult species, many problems were encountered that had to be overcome by the development of new techniques. Examples include:

**Radio-tracking** The process of developing a waterproof radio tag with a safe attachment method was achieved by Glen Tyler and Biotrack Ltd (Wareham, Dorset). This is a difficult process for a new and rare species, requiring a great deal of care and knowledge so that the tag did not affect the behaviour or survival of the birds yet delivered the required data.

**Catching adult male Bitterns** The field skills, patience, ethics and sheer hard work of Glen Tyler and Ken Smith allowed them to develop a way of safely catching Bitterns. This work paved the way for many others to carry out similar research across Europe.

**Vocal individuality** A technique of combining information from territory mapping exercises and information from individual spectrograms was used from 1990 to 2004 to assess the numbers of booming male Bitterns and through this technique we learnt much about male behaviour and yearly survival.

**Nest finding** Gaining an intimate knowledge of the behaviour of the females was crucial in allowing us to find nests. Microwave transmitters then allowed us to film nests to check the effect of our visits to ensure that nests were visited safely.

**Fish sampling** Standard fish-sampling methods were extremely difficult to employ inside a reedbed or wet reed edge. Richard Noble and Iain Cowx from Hull International Fisheries Institute developed an electrofishing 'spider' that allowed fish to be sampled within dense vegetation.

**Elver monitoring** The European Eel is a very important prey item of UK Bitterns. David Mower and Matt Self developed and implemented methods of monitoring the numbers of this important and declining species in key reedbed sites.

**Bed lowering** Geoff Welch and Ian Hawkins at Minsmere and Rick Southwood in the Bure Marshes were among the first brave site managers who had to find ways to use large excavators and machinery not designed for working in swamps, to lower, reform and create wetlands that work for Bitterns. Some plant was lost during the learning curve and at least one crew were extracted from the mire by an air-sea rescue helicopter.

**Battering and re-profiling dykes** The process of crafting ditches to a depth and profile attractive to reed, fish and Bitterns was adopted with relish by some contractors (notably by Kocurek Excavators Ltd and Fen Ditching Company Ltd), some even developing their own bespoke tools for the process.

**Growing and planting reeds** Site managers became experts at planting their own reeds and growing them from seed in polytunnels to cut down on costs. Norman Sills mastered the technique and has grown the millions of seedlings used to populate wet ground at Lakenheath.

**Large-scale creation activity** Paul Burnham at Stodmarsh, Norman Sills at Lakenheath and Sally Mills at Ham Wall were among the earliest to attempt some really large-scale landformings, creating a muddy, hideous, if temporary mess in full public gaze in the process yet having faith and strength of character to see their projects through to successful completion.

structure of the interface between wet reedbed and open water, which needs to allow the fish prey species on which Bitterns depend to become available without requiring the birds to break cover.

A more complete picture of the habitat required by Bitterns was gained once we began to study the females, not least because it is they alone that build the nest and care for the young: the male takes no part in nesting activity, the care of the young or, indeed, of the female. Nest finding (see Box 1) was crucial not only to understanding female-specific habitat choice, but also to understanding which factors influenced productivity, diet, first-year dispersal and survival. Again, the importance of water within the reedbed was found to be an important aspect of female nesting habitat, with females selecting the more undisturbed areas of reed with thicker, stronger vegetation in areas where surface water was likely to remain at some suitable depth through the season (Gilbert *et al.* 2005). Of crucial importance is the availability to the females of an area of open water supporting a healthy fish population of an appropriate species, but it was only by sampling the diet of chicks that we discovered what the suitable fish species might be (at least within the limits of the species available to Bitterns in the UK; Gilbert *et al.* 2003). Bittern diet varies widely across countries, but is almost always dominated by fish.

The fish species taken are invariably those which at some stage in their life penetrate into the littoral wet margins. Species vary in local abundance and availability but those favoured in the UK are Rudd *Scardinius erythrophthalmus* and European Eels *Anguilla anguilla*. Other taxa which are occasionally important in the diet are amphib-

ians, crayfish, mammals and aquatic invertebrates.

Research efforts next focused on obtaining a greater understanding of how to provide the necessary food for Bitterns and on how to make that food available to them. Two quantitative studies explored the relative importance of predation and starvation as causes of chick mortality (Puglisi & Bretagnolle 2005; Gilbert *et al.* 2007), and in the UK starvation was found to be the single most important factor in limiting population recovery and expansion. Bittern populations have the potential to increase or recover quickly, as we know that females and males can breed successfully in their first year (Gilbert *et al.* 2007), males are polygynous (Cramp & Simmons 1977) and females have been proved to produce two broods of young in one season (Mallord *et al.* 2000). However, and unusually among herons in general, the female takes sole care of raising the young (Cramp & Simmons 1977) and the balance for the female of being away from the nest to find food, brooding the young against exposure and protection against predators is a delicate one. If food is hard to find, the females will be away from the nest for longer, leaving chicks more vulnerable to exposure and predation. Research to understand how fish populations behave in reedbeds was crucial in helping identify reedbed designs that would promote year-round access for a healthy fish



Andy Brown

**42.** Not all reedbeds are used by Eurasian Bitterns *Botaurus stellaris*. The tidal reedbeds between Brancaster and Titchwell, in Norfolk, are dry and fishless for most of the year but are deeply flooded by sea water at others, such as when this photograph was taken in August 1997.



**43.** Eurasian Bitterns *Botaurus stellaris* have a varied diet; though dominated by fish, it can also include crayfish, small mammals, aquatic invertebrates and, as on this occasion, amphibians.

population – and access to the fish by Bitterns. Our ability to manipulate fish populations in this way has proved to be especially important in determining the presence and success of nesting females in new or failing sites (Noble *et al.* 2004; Self 2005; see also Box 2).

### Emergency action to recover Bittern numbers – reedbed restoration and creation

There was rapid agreement in the conservation community in the early 1990s that the highest priority should be attached to conservation action for Bitterns. This was given a high public profile on the publication of the UK Government's Biodiversity Action Plan in 1994, which contained specific plans for the recovery of both Bitterns and reedbeds. The ambitious target was to halt and then reverse the decline of Bitterns by creating suitable habitat for 100 'boomers' by 2020. It was esti-

mated that the restoration of existing reedbeds could provide habitat for 30–40 boomers, so new reedbeds, suitable for hosting a further 60 boomers, would be required. Since Bitterns prefer larger reedbeds (rarely being found in those of <20 ha in the mid 1990s), some 1,200 ha of new reed in blocks no smaller than 20 ha was required (UKBAP 1995). This challenging and daunting requirement was justified on the basis that, even in favourable conditions, natural reedbed expansion is too slow, whereas new reedbeds can readily be established in 2–5 years (RSPB 1994).

Emergency action to halt the decline began immediately, although the first projects were rather modest in scale. English Nature (now Natural England) commenced its Bittern Recovery Project in 1994 with an annual budget of £60,000.

The immediate focus was on the restoration of larger reedbeds already in conservation ownership. The project contributed to reedbed restoration projects, for example at Minsmere (RSPB) in Suffolk and at Far Ings (Lincolnshire Wildlife Trust) in Lincolnshire, with the available monies often being matched by the recipients – whether statutory or voluntary sector. The finances also helped to restore privately held reedbeds, as in parts of the Bure Marshes NNR in the Norfolk Broads, and extend some smaller reedbeds, as at Holme (Norfolk Wildlife Trust) and Burnham Overy (part of Holkham Estate, managed by Natural England) in north Norfolk. Boxes 1 and 3 provide more information on some of the pioneering techniques employed during this phase of the work and on key elements of reedbed restoration and construction (see also plate 44).

Action was based on the research evidence



## What we think Bitterns need.

BOX 2

### 1. Larger wetlands

- Large sites (>20 ha), with wet reedbed and particularly those with wet and graduated edges, plenty of variation in edge structure and a good gradation from wet reedbed to macrophyte-rich water.
- Large sites provide newly fledged and first-winter Bitterns with more options than smaller sites. These birds tend to disperse from their natal site, so a surrounding network of wetland feeding and safe roosting opportunities provides them with the best chance of surviving a difficult first winter.

### 2. A wet reedbed

- A significant proportion (minimum 20–30%) of the site should consist of open-water pools or meres with sufficient structure, connectivity, macrophyte assemblage and water quality to support a sustainable fish population in summer as well as in winter, when deeper water refuges are essential.
- The water level across the reedbed should be at least 20 cm deep and should not fluctuate widely. Recent evidence shows that Bitterns can cope well with water 50 cm deep or more. Some reed areas should be free from disturbance to allow nesting, but remain wet for a sufficient period to allow chicks to fledge. Some profiled open-water reedbed edges should remain wet to allow birds access to food even on sites where the water may be drawn down towards the end of the summer to allow for management or cutting.
- A wet reedbed is more likely to deter most native UK mammalian predators than a dry reedbed. This will not apply to American Mink, however, and their numbers should be monitored and individuals controlled.

### 3. Fish

- The fish population should contain species whose behaviour determines that they will use wet reedbed margins (notably Rudd and Eel) and there should be sufficient recruitment into the fish population to allow the smaller age classes to be available.

### 4. Other Bitterns

almost as it was being generated, and so while the process of action and recovery may not always have been 'textbook', it was always based on the best and most recent scientific information available. One major benefit of the 'fast track' between science and restoration action was that those most closely involved in working on the birds had the rather scary luxury of not only seeing their results published in the scientific literature, but also of it being put into action on the ground as it was hot off the press, with their direct involvement occasionally required in drawing up plans for new site designs, restoration works and occasionally in direct-

ing the excavator drivers who were doing the work. There was also a healthy relationship between those advising on and determining strategic spending priorities, researchers and those tasked both to advise on management techniques (e.g. Hawke & Jose 1996) and to carry out the restoration works (Smith *et al.*



Andy Brown

**44.** Reedbed restoration and creation required some lateral thinking and the adoption of some new techniques. Here an excavator bucket, specially modified to create shallow-sided dykes, is in action during the creation of what is now called Stiffkey Fen, Norfolk, in February 1996.

### Key elements of reedbed management, restoration and construction.

Ongoing management – usually annual – to influence succession.

Removing vegetation by cutting, burning or grazing (grazing also can provide structure).

Manipulating water levels, using sluices and other water control structures and by using periodic drying or flooding to hold back succession.

Manipulating the fish population and the access of Bitterns to it.

Mink control.

Monitoring Bittern numbers and productivity, predators present, periodic site audits.

Restoration – one-off larger-scale works.

Changing water control methods, raising water levels or flooding existing low-lying land.

Bed lowering, removing accumulated reed litter and other parts of the substrate.

Enhancing or increasing open water and ditch features.

Creation of new reedbed sites or extensions.

Using known quantitative proportions of what we think Bitterns need, while considering other priority species.

Variability, complex edges, connectivity and gradients are key structural landforming features.

Reed establishment may require growing plugs and planting or putting in rhizomes from elsewhere.

2000). This open dialogue between the various parties was crucial to the development and success of the work. Initially, practical restoration reflected the early scientific results, which showed the importance of larger, wetter reedbeds and of wet feeding edges. In subsequent years, site design and management embraced the emerging scientific findings on Bittern diet, nesting habitat, chick survival and dispersal.

A close and effective working relationship between the statutory and voluntary sectors allowed the programme to escalate quickly. Two consortium bids (led by RSPB and Natural England, but with multi-partnership involvement) to secure major European EU Life-Nature funds provided the financial basis for the necessary multi-site, large-scale work that would really make a difference. The first project funded by EU Life-Nature (from 1996 to 2000) ensured that ‘emergency action’ was taken to restore at least 350 ha of reedbed spread across 13 sites. Most of these were in the core Suffolk/Norfolk breeding area and the number of booming male Bitterns on these sites has since increased from four in 1997 to 31 in 2011. The second project funded by EU Life-Nature (from 2002

to 2006) created more than 300 ha of new reedbed, restored a further 350 ha and restored and created nearly 40 km of ditches on 19 sites. Most of these sites were purposefully away from the core Suffolk/Norfolk breeding areas in order to encourage Bitterns to reoccupy their former range as part of an attempt to give the species a sustainable long-term future in the UK. Since this project began, the number of booming male Bitterns has increased on the relevant sites from 11 in 2002 to 39 in 2011. Much of that increase has so far happened at a small number of the 19 sites that took part in the project, most notably at Ham Wall (RSPB) in Somerset and at Lakenheath (RSPB) in inland Suffolk. Both these sites are large, newly created reedbeds, which have gone from supporting no Bitterns to having 12 and seven booming males respectively in 2011 (Box 4 and plates 45–47).

Restoration and creation works to improve Bittern habitat have taken place at many UK wetlands since 1994, but the scale of habitat manipulation and the ground-works involved has varied considerably among the sites. Some of the most impressive examples have involved sites that might once

have been put back to agricultural use following mineral extraction. Among the largest of such sites is Ouse Fen, in the Cambridgeshire Fens, where RSPB and Tarmac Ltd will eventually complete the creation of a 700-ha wetland. Significant habitat improvements for Bitterns may involve much less obviously impressive feats than the large-scale creation and restoration of reedbed and open waterbodies, however. Just as crucial are the more subtle projects to engineer better water-level controls, restore water quality, manipulate fish populations, or control non-native predators. To date, significant works have taken place at more than 80 reedbeds throughout the UK. Fig. 2 shows the gradual cumulative increase in the area of reedbed restored and created in the UK since 1994 relative to the numbers of booming male Bitterns. Fig. 3 shows the cumulative increase in the numbers of sites carrying out all types of habitat improvement works for Bitterns (one-off improvements, rather than annual reed-cutting management) relative to the numbers of nesting female Bitterns. Box 4 gives more detail of some of the more



Andy Hay (rspb-images.com)



Andy Brown



Norman Sills (rspb-images.com)

**45–47.** A series of Fenland carrot fields near Lakenheath (plate 45, in 1995) were subject to extensive groundworks, re-wetting and reed planting during the late 1990s (plate 46, in 1996) to create a superb wetland home for Eurasian Bitterns *Botaurus stellaris* and much other wildlife (plate 47, in 2005). This and similar works elsewhere have been successful in encouraging Bitterns to increase in numbers and, importantly, to move inland into parts of their former range which are safe from saline inundation.

**Examples of significant reedbed restoration and creation projects in the UK, 1994–2010.**

This is not an exhaustive list, but the sites included are representative of the larger restoration and/or creation schemes from different parts of the UK and with different owner-ships. Bittern numbers are the minimum numbers of booming males and minimum numbers of nests, as counted by annual monitoring, with maximum figures in parentheses. We have listed only the owners/managers of the sites and not all the partners involved in funding the works undertaken. Significant Natural England, Heritage Lottery Fund or EU Life-Nature funding will have made most of these works possible.

**BOX 4**

Site name	County	Approx. current wetland area (ha)	Bittern boomers and nests in 1997	Bittern boomers and nests in 2011	Major works undertaken since 1994	Approx. years since major works started	Owners/managers	Notes
Bure Broads & Marshes SSSI	Norfolk	740	0	3	Bed lowering, scrub removal, mud pumping, ditch and open-water creation	16	Private, Natural England and Norfolk Wildlife Trust	
Castle Water at Rye Harbour LNR	East Sussex	46	0	1	Bed lowering, ditch, island and pool creation	8	Sussex Wildlife Trust	First booming in 2009
Far Ings	Lincolnshire	61	0	2	Bed lowering, bunding, water-level control, ditch and open-water creation and reforming. Further creation of 5 new pits (10 ha) and acquisition of 4 existing pits formerly used for recreation.	16	Lincolnshire Wildlife Trust	Peak of 3 boomers between 1997 and 2010. Nesting in 2000 for first time in 21 years here.
Ham Wall	Somerset	225	0	12 (14)	Complete wetland site creation from peat workings	17	RSPB	First confirmed nesting in 2008
Hen Reedbeds	Suffolk	55	0	2	Bed lowering, pool and ditch creation, water-level control; complete reedbed creation from agricultural land	15	Suffolk Wildlife Trust	
Hickling Broad	Norfolk	560	0	4 (5)	Bed lowering, pool and ditch creation, water-level control; complete reedbed creation from agricultural land	16	Norfolk Wildlife Trust	Boomers and nesting females recolonised in 1999



Examples of significant reedbed restoration and creation projects in the UK, 1994–2010 cont.

BOX 4

Site name	County	Approx. current wetland area (ha)	Bittern boomers and nests in 1997	Bittern boomers and nests in 2011	Major works undertaken since 1994	Approx. years since major works started	Owners/managers	Notes
Kingfishers Bridge	Cambridgeshire	67	0	1 0	Complete wetland site creation from agricultural land	17	Private (Green family), KFB Wetland Trust (leaseholder), Andrew Green and Roger Beecroft (managers)	Booming first reported in 2003, reached a peak of 4 in 2008. There were 4 confirmed nesting attempts in 2007.
Lakenheath Fen	Suffolk (Fens)	230	0	7 (9) 7 (8)	187 ha of wetland created from agricultural land	15	RSPB	First confirmed booming in 2006 and first confirmed nesting in 2009
Leighton Moss	Lancashire	134 (of which 20 ha is willow scrub)	3 1	1 0	Ecosystem restoration involving silt removal, bed lowering, pool and ditch creation	6	RSPB	Regularly 2 confirmed nests between 2000 and 2008
Leighton Moss – Barrowscote and Silverdale Moss	Lancashire	58	0 0	0 0	Complete wetland/reedfen site creation from agricultural land	9	RSPB	
Malltraeth	Anglesey	273	0 0	0 0	Wetland site creation from agricultural land, with only a small original reedbed and lake	17	RSPB	
Middleton Lakes	Warwickshire/Staffordshire	160	0 0	0 0	Complete wetland site creation from mineral workings	3	RSPB, Hanson Aggregates and Staffordshire County Council	

Examples of significant reedbed restoration and creation projects in the UK, 1994–2010 cont.								BOX 4
Site name	County	Approx. current wetland area (ha)	Bittern boomers and nests in 1997	Bittern boomers and nests in 2011	Major works undertaken since 1994	Approx. years since major works started	Owners/managers	Notes
Minsmere	Suffolk	335	2 5	11 (14) 6	Bed lowering, pool and ditch creation, water-level control	17	RSPB	Peak of 11 boomers in 2008 and 12 nests in 1999
North Warren	Suffolk	133	0 0	1 1	Bed lowering, pool and ditch creation, water-level control	15	RSPB	Peak of 3 boomers (2007–09) and 3 nests (2006)
Otmoor	Oxfordshire	394	0 0	0 0	Water-level control, pool and ditch creation: complete wetland creation from agricultural land	14	RSPB/private	
Ouse Fen (Hanson-RSPB wetland project)	Cambridgeshire	60	0 0	0 1 (NB nearby boomers at Fen Drayton)	Complete wetland site creation from mineral workings	9	Hanson RSPB	
Radipole Lake	Dorset	83	0 0	0 0	NE-funded restoration undertaken across c. 50% of the site, over two years, involving the creation or restoration of c. 6 km of ditches and over 1.5 ha of open water (made up of 8 different waterbodies)	3	Weymouth & Portland BC (owners), RSPB (manager)	
Shapwick Heath (east and west, including Meare Heath)	Somerset	495	0 0	9 8 (11)	Complete wetland site creation from peat workings	17	Natural England	

Examples of significant reedbed restoration and creation projects in the UK, 1994–2010 cont.

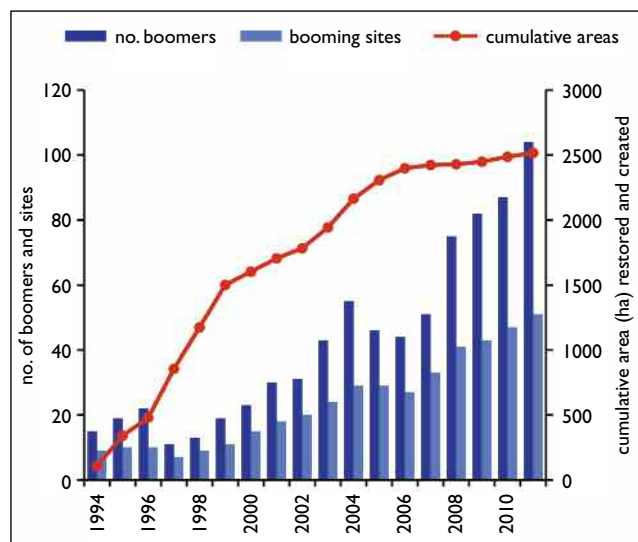
BOX 4

Site name	County	Approx. current wetland area (ha)	Bittern boomers and nests in 1997	Bittern boomers and nests in 2011	Major works undertaken since 1994	Approx. years since major works started	Owners/managers	Notes
Stodmarsh NNR	Kent	249	0 0	1 2 (3)	Bed lowering, ditch restoration and profiling, pool creation, water-level control; complete wetland creation from agricultural land	17	Natural England	Until 2011, no confirmed nesting since the 1970s
Sutton Fen	Norfolk	176	0 0	2 (3) 1	Scrub removal, ditch and open-water restoration and re-profiling	15	RSPB	Peak of 4 boomers in 2008. Occasional nesting attempts (4 out of last 14 years)
Titchwell	Norfolk	(19.5 ha of reedbed)	0 0	1 2	Protection against salt-water flooding, ditch restoration and profiling, pool and ditch creation, raised water levels, reedbed creation	16	RSPB	
Walberswick	Suffolk	398	2 3	5 (6) 2	Bed lowering, pool and ditch creation, raised water levels	16	Natural England	Tidal surges in 2006 and 2007 resulted in saline inundation of much of the site. Between 1997 and 2010, booming has peaked at 8 and nests at 5.
Wigan Flashes	Greater Manchester	150	0 0	0 (1) 0	Bed lowering, pool and ditch creation, water-level control	11	Wigan Council, Lancashire Wildlife Trust	

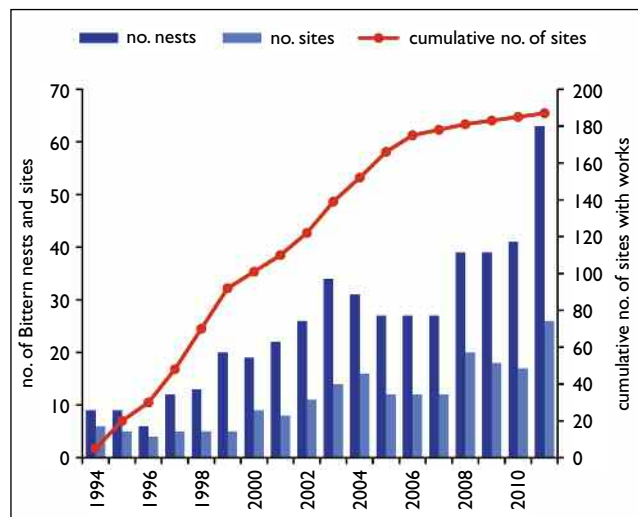
significant and influential restoration and creation projects.

Not all the work at reedbed restoration sites was aimed at attracting breeding Bitterns; some of the reedbeds were small, but could provide a lifeline as wintering habitat for dispersing UK breeding birds or visiting

continental birds. The geographic location of improved sites is very important and whenever a choice of restoration location was available, consideration from an early stage was given to extending the range of the population, in order to create more than one core area of productivity. This was an especially important consideration as the productive UK populations were by 1997 almost all along the East Anglian coastline where many sites are highly vulnerable to inundation by sea water during storms (which climate-change models predict will increase in severity and frequency as our climate changes; Gilbert *et al.* 2010). The second EU Life-Nature-funded project was the first and largest project of its kind in the UK aimed at safeguarding a species' habitat in the face of imminent changes due to climate change.



**Fig. 2.** The numbers of booming male Eurasian Bitterns *Botaurus stellaris* and occupied sites in the UK since 1994 in relation to the estimated cumulative area (in ha) of restored and newly created reedbed combined.



**Fig. 3.** The number of active Eurasian Bittern *Botaurus stellaris* nests and occupied sites since 1994 relative to the cumulative number of sites at which significant one-off habitat improvement works had taken place. Because significant work was undertaken over several years on some sites, the total number of sites at which work was undertaken in any one year is not meaningful. The actual total number of sites involved was 86.

## The response of Bitterns

The response by Bitterns (fig. 4) to conservation action has been both rapid and spectacular and is an excellent example of what can be achieved with highly targeted action. The minimum number of booming males increased year on year from the 1997 nadir to 2004. There were fears that the increase had stalled in 2005 but numbers increased again from 2007, and by 2011 the total population reached 104 boomers – almost certainly the highest number recorded since recolonisation in the early years of the twentieth century (Wotton *et al.* 2011). The number of sites occupied has increased during this period from a low of seven in 1997 to 51 in 2011 while the number of known nests has increased from just six in 1996 to 63 in 2011.

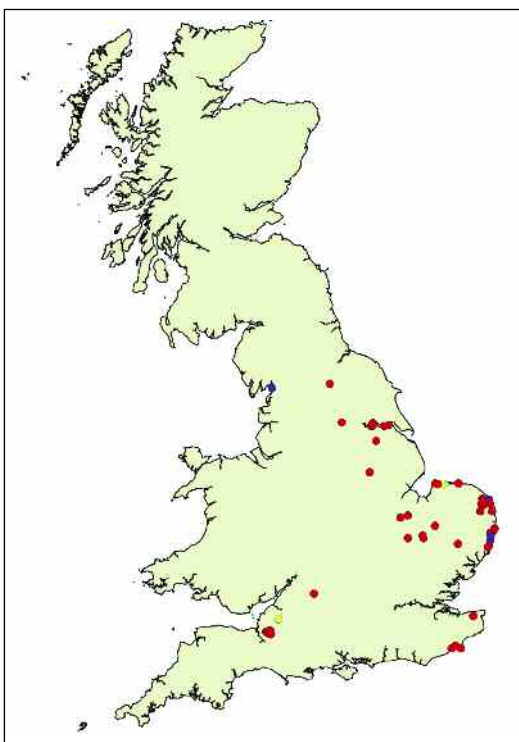


The pattern of increase is fascinating. At first, numbers increased at existing sites which had been restored, almost certainly because birds at these sites became more productive. At Minsmere (RSPB) and Walberswick (managed by Natural England) in Suffolk and Hickling (Norfolk Wildlife Trust) in Norfolk, boomers increased from two, two and none in 1997 to 11, five and four respectively in 2011. However, Bitterns soon began to return to long-abandoned sites that had been restored. North Warren (RSPB) and Hen Reedbeds (Suffolk Wildlife Trust) in Suffolk, for example, were both totally transformed by major excavation works from 1996, and were recolonised by Bitterns in 2000 and 2001 respectively. From 1998 signs of success were seen farther away from the core Norfolk and Suffolk sites. Along the Humber, the major works at Far Ings (Lincolnshire Wildlife Trust) bore fruit as booming birds returned to this area in 1998 and they have nested regularly along the Humber shore since 2000. A few sites had been colonised by boomers in both southeast (Stodmarsh, in Kent) and southwest England (two sites in Somerset and one in Devon) by 1998. Nesting has been regular in the southwest since 2008, and in the southeast there was one nest in 2010 and four in 2011. Fenland (Cambridgeshire and the western edges of Norfolk and Suffolk) saw the return of booming birds in 2002 and birds have nested in this area annually since 2007. Most recently, Bitterns have begun to breed in brand-new sites created specifically for them, such as Kingfishers Bridge (privately owned) in Cambridgeshire (booming since 2003, nesting since 2007), Ham Wall (RSPB) in Somerset (booming since 2003, nesting since 2008 and Lakenheath (RSPB) in Suffolk (booming since 2006 and nesting since 2009).

All of the boomers between 1990 and 2003 were in England. The first to be found in Wales was at Malltraeth in 2004 but booming has only occasionally been reported in Wales and successful breeding has yet to take place there. There were also reports of birds booming for very brief periods at two sites in Scotland and also at one site in Ireland (in Co. Wexford) in 2011. These records hold out the promise

that the species may soon return to these countries and to Northern Ireland.

Overall, however, there has been a very significant increase in the species' UK range, with nesting having taken place in nine English counties in the last three years alone. In 2011, 63 Bittern nests were identified at a total of 26 sites in eight counties. Just as Broadland held the core breeding population and fuelled population recovery until the 1950s, so productive Bitterns from the Suffolk coast fuelled recovery since the late 1990s. Although the Broadland population has not yet regained the strength and stability that it once had (fig. 1), this area and the nearby Norfolk and Suffolk coastal reedbeds held 48 of the UK's 104 boomers (46%) and 25 of the 63 nests (40%) located in the UK in 2011. This is rather worrying, however, as many of these sites are highly vulnerable to salt-water incursion and tidal inundation. Not all are immediately vulnerable, but equally, coastal areas elsewhere in eastern and southern England (such as the



**Fig. 4.** The distribution of sites occupied by booming male Eurasian Bitterns *Botaurus stellaris* in the UK in 1997 and 2011. Yellow sites were occupied in 1997 only, red in 2011 only, blue in both years. Seven sites were occupied by 11 Bitterns in 1997, 51 sites by 104 Bitterns in 2011.

Philip Amies



Philip Amies



Philip Amies



**48–50.** Eurasian Bitterns *Botaurus stellaris* can swim. Here, a near-fledged bird traverses open water at Thornham, Norfolk, in June 2011, passing a party of Gadwalls *Anas strepera* and a female Common Pochard *Aythya ferina* with two ducklings (plate 48). But such adventures are not without risk and, as this series of photographs shows, the female Pochard was clearly unimpressed by the proximity of this potential predator and eventually gave chase, with the Bittern turning tail and crashing back into the reeds from which it had just emerged.

Humber Bank) are, so we have reason to be concerned for the long-term future of the reedbeds currently used by about half the UK Bittern population.

Every year continental Bitterns winter in UK wetlands and almost certainly it was such birds that recolonised England in 1911. By contrast, population models of the recent recovery show a strong link between the numbers of UK young fledged and population growth, so it seems likely that the recent Bittern recovery has been – and continues to be – largely dependent on the success of recruitment from within the UK population, rather than on occasional incidents of wintering birds deciding to stay to breed. Some 86% of the 51 sites occupied by booming male Bitterns in 2011 have received at least some Bittern-focused restorative work to enhance the existing wetland habitat. There is strong correlative evidence (but not causal, or experimental) that the recent habitat improvements have been responsible for the recovery in the size of the UK Bittern population. We know that much of the habitat used now simply did not exist previously, or that food was not available even where apparently suitable habitat did exist. We should acknowledge, however, that a number of sites where significant work has been carried out have not yet achieved their goals in terms of numbers of Bitterns. Assuming that the habitat improvements have been carried out correctly, the main reasons for a lack of success are likely to

include the following: distance from a source of colonisation (isolated and smaller sites far from other sources of dispersing young UK Bitterns are likely to rely on overwinter survival of their own young, possibly off site and returning to breed); a lack of food (the fish population is not quite large enough or contains the less-preferred

species); or predation (there may be more of an influence of Mink *Mustela vison* than expected, which can be very difficult to assess without monitoring). Moreover, some sites have unusual problems, which have become apparent only after work has been carried out – mostly involving water quality, water quantity and the effects of invasive species, all of which can be very difficult to solve.

Notwithstanding the fact that our winter-visiting Bitterns tend to return to their natal areas abroad, UK reedbeds are becoming increasingly important for Bitterns in winter, with higher numbers recorded at a number of sites across the UK, including many which do not currently support booming males in the breeding season. During the 2009/10 winter, Wotton *et al.* (2011) estimated that there were a minimum of 598 Bitterns wintering in the UK, of which an estimated 208 (35%) were resident birds, with the remainder from continental Europe. While it is not possible to say for certain that there has been a real increase in the numbers of wintering Bitterns in the UK in recent years, numbers of breeding birds both in the UK and elsewhere in northern Europe are increasing (BirdLife International 2004).

## Keeping on track

Although we now have an idea of what type of wetlands are preferred by the UK's Bitterns, we must always bear in mind that our best evidence comes from research



Andy Brown

**51.** An early sign of success as a brood of Eurasian Bitterns *Botaurus stellaris* is taken in hand for ringing and for the attachment of radio transmitters Minsmere, Suffolk, August 1998.



Philip Amies



**52.** Two near-fledged Eurasian Bittern *Botaurus stellaris* chicks stand at the reed edge at Thornham, Norfolk, in June 2011.

Philip Amies



**53.** Four near-fledged Eurasian Bittern *Botaurus stellaris* chicks in a rushy field at Thornham, Norfolk, in June 2011, waiting for the arrival of their mother with food.

Philip Amies



**54.** Two barely concealed Eurasian Bittern *Botaurus stellaris* fledglings in a pathside reedbed at Thornham in Norfolk, June 2011.

conducted on a population on the brink of extinction, occupying the most altered of freshwater wetlands on the western edge of an almost global range. We also need to acknowledge that our evidence, although invaluable, is almost ten years old. We should thus remain receptive to all the waves of new information that come across our bows, both from within the UK as our population expands and from other countries as new and exciting research is completed. We are aware of particular needs in respect of water levels, both the levels that Bitterns can do well in and the seasonal levels that are healthy for a wetland system. Even if we do not conduct another full-scale research programme on Bitterns in the UK, we should review new information regularly and update our advice and action on the ground accordingly.

Reedbed wetlands are dynamic ecosystems; like many others, they are constantly changing. Almost as soon as major works have been completed, a regime of near-annual management is required to maintain the desired conditions, notably those typical of an early successional reedbed. This can be a difficult proposition in the more inaccessible parts of our larger reedbeds and at sites where site managers seek to provide for the complex habitat requirements of a broader suite of key species (avian and non-avian) with slightly different requirements.

One way of monitoring conditions at the key sites is to conduct formal reedbed 'audits'. These are periodic stocktakes, which use a standard assessment of habitat condition between years and between sites. Each



reedbed is unique and, therefore, regardless of overall national targets, has its own constraints, so specific visits that access the heart of the habitat and collect data that is measureable both between sites and within the site over time is crucial. Each audit commences with a general overview of the site – its area and conservation objectives, its water quantity, quality and control, the general state of the reed, the area cut, the length of rotations involved and the details of any major works conducted within the last decade. Attention is also given to fish and Bittern stocks, particularly to their productivity. Any issues such as drying, scrub encroachment, invasive plants or the security of funding for management are identified. A specific assessment is made of reed age, structure, height, stem density, litter depth, presence of aquatic macrophytes and other plant species, of water levels, open-water depths and edge complexity at a number of sampling sites within the reedbed. The scope of each audit also takes into account an assessment of the fish population and of any potential predators present – this latter notably requiring some long-term monitoring of Mink presence. The attributes are scored and these compared against target scores to determine the overall state of the reedbed. The information obtained during these visits is used by the statutory conservation agencies in formal site condition assessment, by researchers and reserves managers

to identify broad trends across the nation's reedbeds and to aid identification of local issues, which can then be addressed by targeted interventions on appropriate sites. The RSPB operates a system of site auditing for its own sites but it also runs courses to train others in how best to make the most of this process and many key reedbeds have now been audited in this way.

### Reedbed use by other wildlife: the wider biodiversity benefits of action for Bitterns

As a highly specialised habitat, reedbeds support a rather limited flora and fauna. Among this habitat's characteristic species, however, are a number which are reedbed specialists, range-restricted, declining, nationally scarce or rare and many are also UK BAP Priority Species (Box 5). Until very recently, most – if not all – of the information that we have on how the creation, restoration and management of reedbeds for Bitterns has benefited these and other taxa is anecdotal or highly site-specific. Nevertheless, and especially where reedbed specialists or UK BAP Priority Species are known to be present on a site, their needs have always been considered as part of the process for planning and undertaking significant management works. It has also been the case (certainly with multi-partner projects) that although most of the money for major works has been secured with the Bittern as the



Graham Catley

55. Eurasian Bittern *Botaurus stellaris* in flight, north Lincolnshire, August 2006.

## Some other reedbed inhabitants likely to be affected by management for Bitterns. BAP Priority Species are coloured red.

Information and evidence from the RSPB/NE Bringing Reedbeds to Life project (Chloe Hardiman *in litt.*).

Species group	Possible effects of reedbed restoration and creation on other wildlife
Mammals	Otter <i>Lutra lutra</i> , Water Vole <i>Arvicola terrestris</i> , Water Shrew <i>Neomys fodiens</i> , Red Deer <i>Cervus elaphus</i> and Roe Deer <i>Capreolus capreolus</i> are found within UK reedbeds and their behaviour suggests that they offer important refuges and benefit their numbers; but the only evidence for this is for Water Vole, for which reedbeds provide a refuge from Mink <i>Mustela vison</i> predation (Carter & Bright 2003; Macpherson & Bright 2010).
Birds	Marsh Harrier <i>Circus aeruginosus</i> , Bearded Tit <i>Panurus biarmicus</i> , Reed Warbler <i>Acrocephalus scirpaceus</i> , Sedge Warbler <i>A. schoenobaenus</i> and Common Crane <i>Grus grus</i> will almost certainly have benefited from the increased area of undisturbed reed, wetter reedbeds making access by some predators more difficult and an increase in the reed/water interface where some of them prefer to nest and feed.  Grasshopper Warbler <i>Locustella naevia</i> , Savi's Warbler <i>L. luscinioides</i> and Cetti's Warbler <i>Cettia cetti</i> are associated with reedbeds, but are only likely to have benefited from Bittern management or habitat creation in larger reedbeds, where reed of a variety of ages and structures is available. These species require scrub and a dense litter layer, or a layer of dead vegetation. Bittern habitat management aims to reduce scrub and litter, so the needs of these warblers would have to be specifically taken into account in whole-site plans.
Fish	European Eels <i>Anguilla anguilla</i> should benefit from the availability of a greater number of freshwater sites close to the coast. However, the high degree of hydrological management at many of these sites has meant that elvers may be able to access them only if elver passes have been provided or there is more sympathetic water management. There is little evidence as to how much eels have benefited in practice.  Species such as Minnows <i>Phoxinus phoxinus</i> , Three-spined Sticklebacks <i>Gasterosteus aculeatus</i> and Rudd <i>Scardinius erythrophthalmus</i> will have benefited from Bittern management where water levels have been raised or the beds lowered and dykes profiled to allow the fish access to the reedbeds, and, especially, where new pools, meres and deep-water winter refugia have been created.
Amphibians	Common Frogs <i>Rana temporaria</i> use seasonally flooded areas, Smooth Newts <i>Lissotriton vulgaris</i> use well-vegetated ditches and Common Toads <i>Bufo bufo</i> use ditches, so increases in the extent of these habitats associated with reedbed restoration activity should be beneficial. However, increased fish stocks to benefit Bitterns may be detrimental to these amphibians; Great Crested Newts <i>Triturus cristatus</i> in particular are very sensitive to fish predation.
Lepidoptera	Reed Leopard <i>Phragmataecia castaneae</i> is considered a vulnerable moth which feeds on reed stems. Reed Dagger <i>Simyra albovenosa</i> is a litter-dwelling reedbed specialist. Adults of both species have been trapped at sites created using EU LIFE funding with Bittern requirements in mind.  There are a number of other moth species associated with reedbeds, for example Flame Wainscot <i>Mythimna flamma</i> , Fenn's Wainscot <i>Photodes brevilinea</i> , White-mantled Wainscot <i>Archanara neurica</i> , Obscure Wainscot <i>M. obsoleta</i> , Twin-spotted Wainscot <i>A. geminipuncta</i> , Brown-veined Wainscot <i>A. dissoluta</i> , Silky Wainscot <i>Chilodes maritimus</i> . It is not known how these species have or have not benefited from reedbed works associated with Bitterns. To the extent that new reedbeds have been created and the life of 'mature' reedbeds has been extended by setting back seral succession, we might expect that, overall, they will have benefited.
Diptera	Scarce diptera <i>Cryptonevra nigritarsis</i> and <i>Sphaerophoria loewi</i> are associated with <i>Phragmites</i> , and may have benefited from reedbeds created and managed for Bitterns, having been recorded at a site created with Bitterns in mind.
Coleoptera	A nationally scarce carabid ground beetle <i>Paradromius longiceps</i> is a reedbed specialist. It has been recorded from dry reedbed at a site that also has successful breeding Bitterns.

## UK BAP Bittern targets 2010–2030

BOX 6

	Number of booming males	Number of sites with booming males	Booming males not at risk of saline incursion
2010 actual	87 England, 0 Wales	47 England, 0 Wales	38 England, 0 Wales
2010 target	58 England, 2 Wales	31 England, 1 Wales	22 England, 2 Wales
2015 target	74 England, 5 Wales, 1 Scotland	34 England, 2 Wales, 1 Scotland	34 England, 5 Wales, 1 Scotland
2020 target	110	44	66
2030 target	190	64	133

figurehead species, what is known of the needs of many others have been built into the creation, restoration and management plans.

In recognition of this deficiency of information, a new research project, *Bringing Reedbeds to Life* (see [www.rspb.org.uk](http://www.rspb.org.uk) for details), jointly funded by RSPB and Natural England, is underway and, for the first time, will allow a quantitative assessment of how reedbeds benefit wildlife other than Bitterns. This information will be particularly useful for invertebrates, which are probably the most difficult group to study and for which we have least information.

### A future for Bitterns in the UK

The bird conservation community should be rightly proud of all that has been achieved for

Bitterns, for reedbeds and for their associated wildlife. The original UKBAP targets for both Bitterns and reedbeds were met – and met well ahead of time and, with the exception of booming in Wales, the targets for 2010 have also been met (Box 6). However, we should not be complacent, for there remains much to be done to provide a secure future for Bitterns in the UK. Although we have already exceeded the UK BAP targets for England, a considerable new effort will be required if the targets for Wales and for Scotland are to be met. Even in England, although we are close to achieving our 2020 numerical targets we must remember that we have not achieved them quite yet. Even at currently successful sites, we must keep a close eye on the four essential components of Bittern conservation:



Dave Rogers

**56.** The extraordinary sight of a female Eurasian Bittern *Botaurus stellaris* feeding one of its youngsters out in the open at Stodmarsh, Kent, in September 2011. Similar events were witnessed at Thornham, Norfolk, in June 2011. With increasing numbers of Bitterns and of digital camera-wielding birdwatchers, we may be able to share more such unusual sights and come to learn more of the habits of these exceptionally secretive birds.

Andy Brown



**57.** Reconciling the needs of reed cutters with those of Eurasian Bitterns *Botaurus stellaris* at more sites may be one means of ensuring that the future management of reedbeds is both affordable and sustainable. Here thatching reed lies cut and bundled ready for removal at Cley, Norfolk, in March 1996.

the reedbed habitat, seasonal water levels, available and sustainable fish populations, and the presence of predators such as Mink. In particular, renewed focus on the dynamics of fish populations in often closed and highly managed sites and the relationship between seasonal water levels and reedbed health will almost certainly pay dividends. We have now built a wealth of experience of managing reedbeds; however, the costs of retarding or setting back seral succession are considerable and all those with responsibility for reedbed management must ensure that these costs are met. Greater consideration thus needs to be

tionists can be reconciled – the former prefer an annual or short-rotation cut while the water levels are drawn down in late winter and early spring, whereas Bitterns require long-rotation reed stands with high water levels in late winter, spring and early summer.

There is, of course, considerable merit in extending the area of wetland within which the important Bittern reedbeds sit and, especially, in trying to reconnect reedbeds and their floodplains with the rivers that should feed them. However, progress on these grand, landscape-scale initiatives is slow, and substantial and costly management intervention

will be needed for many years before ‘natural processes’ can operate at a landscape scale and take over again from the hand of humans.

Effort in creating new areas of reed needs to continue and, indeed, must accelerate. This is because many of our largest reedbeds – those containing a substantial proportion of the national Bittern population – are in coastal East

Andy Brown



**58.** A fine line – often a thin strip of sand or shingle – separates some of our most important Eurasian Bittern *Botaurus stellaris* reedbeds from the open sea, as here at Easton Broad, Suffolk, in September 1997.



Anglia and highly vulnerable to tidal inundation. New reedbeds will thus need to be created inland, in low-lying areas capable of holding large amounts of fresh water. New areas will be needed both to ensure that ambitious biodiversity targets are met and to compensate for those key sites that will be lost as the coast is intentionally realigned to protect it and the surrounding human population in the long term. We shall also need to encourage a move westwards and northwards to ensure that the new reedbeds we create are likely to be *wet* reedbeds and remain so over the long term, given that the climate of the east and southeast, where most of our Bitterns are currently found, is predicted to change towards drier springs and summers, which are times critical to the Bittern life-cycle. This should give even more legitimacy for greater restoration and creation activity in Scotland, Wales and Ireland.

Our aspirations for Bitterns, as expressed by our biodiversity targets, have been integrated into those for reedbeds and for freshwater wetlands more broadly. There is now a well-established national 'vision' for wetlands (Wetland Vision 2008), which takes account of UKBAP creation targets and requirements resulting from the likely consequences of sea-level rise and other effects of climate change. It encourages an ambitious, large-scale approach to wetland creation over a 50-year period. The Environment Agency has also initiated the Regional Habitat Creation Programme (RHCP), which identifies land suitable for wetland creation in cases where there is a statutory need to replace land lost from Special Protection Areas after necessary management works have led to saline inundation of coastal fresh waters (Huggett *et al.* 2006). The realisation of the Wetland

Vision and the RHCP will do much to ensure that Bitterns and the reedbeds they inhabit will have a secure future in the UK.

A number of large-scale wetland creation projects, which will result in the creation of a very significant area of new reed suitable for Bitterns, are currently underway, with the £6 million funding from Natural England's Wetland Vision programme being matched by other funds raised by project consortia. Among the larger of these projects are the 'Wissey Living Landscape' spearheaded by the Norfolk Wildlife Trust, the Humberhead Levels Partnership led by Natural England, the Midland Meres and Mosses project led by the Shropshire Wildlife Trust, the Willow Farm Project in the catchment of the River Glen led by Lincolnshire Wildlife Trust, and initiatives in the Lyth Valley in Cumbria and Somerset Levels that are RSPB-led. Three much larger-scale projects are in the early phases of development in the East Anglian Fens. RSPB and Hanson aim to create 700 ha of wetland once mineral extraction has ceased in the vicinity of Needingworth and Over (Cambridgeshire) and the aim is for much of this to be reedbed suitable for Bitterns. Nearby, the National Trust has an ambitious plan for wetland creation around its Wicken Fen reserve, with a footprint of some 5,500 ha, and to the north, the Wildlife Trust for Bedfordshire, Cambridgeshire and



Andy Brown

**59.** Many reedbeds important to Eurasian Bitterns *Botaurus stellaris* are in coastal areas highly susceptible to saline inundation, such as this one at Cley, Norfolk, in March 1996. While reedbeds may recover from periodic incursions, rising sea-levels have very significant implications for the long-term future of Bitterns in this country.



Northamptonshire, Natural England, the Environment Agency, Huntingdon District Council and Middle Level Commissioners are creating the vast 'Great Fen' on an area of over 3,700 ha, with 1,500 ha of new wetland already in the first phase of establishment on former agricultural land (itself, of course, a former wetland) in the northeast of the project area where it links two existing wetland NNRs at Woodwalton and Holme Fen. The fact that these large-scale projects are already underway should be good news for Bitterns because we know from recent experience that it takes about a decade before new reedbeds are colonised by Bitterns. Therefore, providing that a sufficient area of suitable reed is in place by 2020, we should be on course to meet our 2030 targets.

The Bittern will always require a considerable effort to retain it as part of our avifauna. Site managers will need to remain well informed of conditions in their reedbeds by conducting regular audits of water quantity and quality, of reed extent and structure, and of fish and amphibian populations, in addition to conducting essential monitoring work on Bittern numbers and productivity. The costs will not be insubstantial but the gains – for Bitterns, for reedbeds, for wetland biodiversity more broadly and for the growing number of people who visit and rejoice in our new and rejuvenated wetlands – will be immeasurable.

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Bittern monitoring and conservation action in the UK has involved a large number and wide diversity of committed individuals. Their number include many researchers, site managers, landowners and surveyors – both professional and voluntary. We trust that the start of recovery, described here, is sufficient testimony to their sterling efforts. The early insights into Bittern ecology and the promotion of conservation action for Bitterns owe much to the work of Glen Tyler; Ken Smith and Paul Jose. The UK Bittern monitoring scheme is funded by RSPB and Natural England as part of its Action for Birds in England programme.

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Graham Catley

**60.** A Eurasian Bittern *Botaurus stellaris* is seen here over the Humber reedbeds in February 2007, with the iconic Humber Bridge in the background.