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Short communication

Nesting habitat selection by bitterns *Botaurus stellaris* in Britain and the implications for wetland management

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Abstract

The rarity and decline of the bittern *Botaurus stellaris* in Britain has prompted large-scale wetland restoration and more recently, wetland creation projects. In order to guide such habitat management, we investigated whether any large or fine-scale features within British wetland sites best described the selection of female bittern nesting positions. Birds nested in continuous vegetation (usually *Phragmites* dominated) that was on average 100 m at its narrowest width. When compared with random locations, nests had less scrub and more vegetated open water edge in their wider vicinity and were immediately surrounded by smaller percentage coverage of non-*Phragmites* species and thicker *Phragmites* stems. Of most importance, female bitterns nested at points where deeper water was maintained into the driest part of the season, perhaps using the presence of water tolerant plant species as an indication of this. The results can be used to aid the design of new wetland sites to take into account the needs of nesting female bittern.

Keywords: Bittern; Bird; Nesting habitat; Female; Reedbed; Phragmites

1. Introduction

The bittern *Botaurus stellaris* is an important target species for large-scale wetland conservation in Britain (Hawke and Jose, 1996; White and Gilbert, 2003). It has a high profile and is a favourite of the press and public, despite its rarity, cryptic plumage and secretive nature. Since recolonisation early last century (Turner, 1924), numbers increased to a peak of about 70 booming (singing) males in the 1950s (Day and Wilson, 1978), but then fell to fewer than 20 by the 1990s, with similar declines witnessed in many other countries in Western Europe (Day, 1981; Tucker and Heath, 1994). By 1997 there were only eleven booming male bitterns in the UK, these were mainly within the Counties of Norfolk and Suffolk (southeast England), with a small outlying population at Leighton Moss in the County of Lancashire (northwest England). Bittern is on the red list of UK Birds of Conservation Concern, due to its historic decline and rarity (Gregory et al., 2002). It is restricted to reedbed *Phragmites australis* dominated habitat, which is vulnerable to loss and degradation, and has itself become relatively scarce (Gilbert et al., 1996). Action plans set for priority habitats and species, contain targets to increase reedbed habitat of all kinds in Britain (UK Biodiversity Group, 1998a) as well as halting the decline and increasing the breeding population of bittern (UK Biodiversity Group, 1998b).

Habitat management recommendations (RSPB, 1996, 2001; Hawke and Jose, 1996) have been based on data collected at two scales. Habitat comparisons

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at the scale of whole sites (Tyler, 1994; Tyler et al., 1998) and the detailed behaviour and habitat selection of territorial males within individual sites (Gilbert et al., 2005). In addition, it is important to understand female bittern habitat needs over and above those of the males, which have little or no role in the nesting process. Females cannot be located by territorial vocalisation and their nests tend to be difficult to access; so there have been no studies of their habitat preference on which recommendations could be based. The aim of this paper is to characterise the nesting habitat preferences of female bitterns in Britain and to discuss the results in terms of habitat management that will aid their conservation.

2. Methods

A total of 74 bittern nests were visited on 11 protected nature reserve sites in England between 1997 and 2001 (Table 1). Of these sites, Leighton Moss (latitude: 54°10′03″ N, longitude: 02°47′31″ W) and Minsmere (latitude: 52°18′55″ N, longitude: 01°38′02″ E) are named, but the rest are given codes to protect their identity. The nine coded sites are located in the English counties of Norfolk (codenames: Norfolk 1, 2 and Broads 1, 2), Suffolk (codenames: Suffolk 2–5) and Lincolnshire (codename Lincs). The wetland habitat at these sites was predominantly a mix of *Phragmites australis* and open water, with some mixed fen, wet woodland and wet grassland. The size of the wetland component of these sites varied from 20 ha to more than 400 ha. At each site a series of habitat measurements were made relative to nests and randomly selected points. These measures were taken at two different scales to emulate the kind of choices a female bittern might make about where to nest. Large-scale macrovariables were measured from a bird's eye view (aerial photographs) above the reedbed and small-scale microvariables were measured on the ground inside the reedbed. Microvariables (Table 2, Group 3) were measured within 4 m^2 quadrats placed around nests and random points, using the same method as Tyler et al. (1998). Macrovariables of the same nests and random points (Table 2, Group 2), were measured from aerial photographs obtained for as near to the middle of the study period as possible (usually 1999). These rectified photographs were digitised using MapInfo Professional Version 6 (MapInfo Corporation, 2000). Some measurements at both scales were percentage vegetation cover estimates of an area around nests and random points. These areas, were either a 4 m^2 quadrat (microvariables), or a 100 m radius circle (macrovariable) (Table 2). Microvariable measurements at each nest were taken at the end of the breeding season to keep disturbance to the birds at an absolute minimum. Due to the nature of the habitat, excess trampling or disturbance of vegetation becomes obvious and could leave the nests more vulnerable to predation. Measurements were made as soon after breeding as possible to reduce any seasonal affect on vegetation. Water depth relative to a standard gauge-board reading was known accurately for nests at five sites. This enabled calculation of the water depth at 34 nests (taking account of pseudoreplication, see below). Analyses of nest site selection that included water level measures therefore involved data from 34 independent nests and 125 (25 from each of 5 sites) random positions. Two water level measures were calculated for each nest or random point, the first on the estimated first egg laying date and the second on September 1st, assumed to be the driest point of the year. The first egg laying date was estimated by back-calculating from the estimated age of the nest to the first egg date, assuming 26 days of incubation (Cramp, 1992). The age of nests was estimated as follows: 6 from the known hatch date and 28 from the

Table 1
The number of bittern nests visited at sites in Britain 1997–2001 from which data were collected on nest characteristics

Sites	1997		1998		1999		2000		2001	
	V	I	V	I	V	I	V	I	V	I
Leighton			1	1			2	2	1	1
Minsmere	5	2	6	2	12	10	6	2	10	9
Suffolk 2			3	1	5	5	4	3	2	0
Suffolk 3							1	1	1	0
Broads 2					1	1	1	0		
Broads 1			1	1						
Lincs							1	1	3	2
Suffolk 4									1	1
Suffolk 5									1	1
Norfolk 2							1	1		
Norfolk 1	1	0	2	2	1	1	1	0		
Totals	6	2	13	7	19	17	17	10	19	14

Columns headed "V", contain the number of visited active nests, those headed "I", indicate the number of nests included in analyses after pseudoreplication had been taken into account. Sites other than Leighton Moss and Minsmere are coded for confidentiality reasons.