

Do Reed Bunting, *Emberiza schoeniclus*, when breeding near rivers, depend on the quality of the river habitat for success? A critical assessment of the available evidence

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Summary

The available evidence with regard to reed bunting presence as an indicator of riverine habitat quality is patchy, but generally suggests that reed buntings nest in a wide variety of habitats and that those which breed along rivers are not entirely dependent on good quality river habitat. It is recommended that it should be removed from the 'A' list of qualifying species for rivers in the UK BAP Priority Habitat Definition and moved, instead, to the 'B' list.

Introduction

There has been some debate as to whether reed bunting, *Emberiza schoeniclus*, should remain in its current status as a qualifying species in category A for rivers in the UK BAP Priority Habitat Definition. There have been suggestions from within and outwith the JNCC that the presence of breeding reed buntings does not necessarily depend on or indicate good quality riverine habitat and, indeed, may indicate stretches of river affected by pollution and subsequent eutrophication resulting in the growth of dense rank vegetation along river banks suitable as reed bunting nesting sites. The British Trust for Ornithology (BTO) has been asked to conduct a literature review asking the question "What evidence is there that reed buntings breeding near rivers rely on the quality of the river habitat for success?" and to provide an objective, independent assessment of whether the scientific literature is good enough to answer this question.

Methods

A systematic review was undertaken using Pullin and Stewart (2006) as a guideline for best practice. Cramp *et al* (1994) was consulted as a reference for reed bunting breeding habitat requirements and diet, and Baillie *et al* (2010) was consulted to view the recent reed bunting population trends in the UK. Literature searches were made through a number of media. An OPAC search of the BTO library with the search term 'reed bunting' was made, with 9 positive results, 6 of which were books or reports (one in Spanish) and 3 of which were periodical articles. Searches were conducted through ISI Web of Knowledge, the search terms used were "('reed bunting' OR '*Emberiza schoeniclus*') AND 'river'" (4 results), "('reed bunting' OR '*Emberiza schoeniclus*') AND 'breeding'" (47 results) and "('reed bunting' OR '*Emberiza schoeniclus*')" (124 results). Google Scholar was also used with search terms "'reed bunting' river" (1070 results), "'reed bunting' breeding" (2310 results), "'water quality' 'reed bunting'" (165 results), "'reed bunting' 'breeding habitat'" (236 results), "'reed bunting' 'river habitat'" (15 results) and "'reed bunting' eutrophication" (107 results). All articles investigated on-line were in English.

Expert advice was sought on past research, publications and data availability from Gavin Siriwardena, Niall Burton and Dave Leech at the BTO and Robert Prys-Jones at the Natural History Museum, Tring, all of whom have past experience working on reed bunting ecology.

The titles of publications listed in search results, or in the first few pages of results where high numbers of results were listed, were scanned for potential relevance to the question posed, specifically for reference to reed bunting along with a combination of one or more of breeding habitat, rivers and habitat quality. Where a publication was deemed potentially relevant the abstract and, when available, the full text of the article, were obtained. For each article obtained the list of references was also scanned for potentially relevant cited articles and the availability of such was investigated.

Results

Publications and Contents

A summary of some of the more relevant publications follows below, a full list of publications cited is found in the reference section.

Cramp *et al* (1994): It is clear that reed bunting occupies a large range of habitats during the spring/summer breeding season within the general restriction of dense and prolific fairly low vegetation mainly associated with intense soil moisture. These include tall herbage and small shrubs in marshy and swampy areas bordering fresh or brackish water of all kinds, including riversides, mainly in the lowlands in the UK, and also reedbeds, wet meadows and peat bogs. These habitats have recently expanded to include drier habitats such as young conifer plantations and arable fields, although this is at a much lower density than for wetland breeding habitats. Breeding season diet is made up of many different orders of invertebrates, taken on the ground among sedges, rushes, marshy grasslands among others vegetation and low in waterside bushes and trees or on the stems of *Phragmites* reeds. Important invertebrates vary through the season, but in Oxfordshire include springtails and Diptera (flies, mainly gnats) in March, also Lepidoptera larvae (caterpillars) in April to May, Araneae (spiders) and Odonata (dragonflies and damselflies) in June to July. Nestlings are fed only invertebrates including spiders, Lepidoptera larvae, Diptera (including crane flies), Hymenoptera and beetles; adult and larval. Nesting is normally on or near the ground, so the species requires ground that is not inundated, in tussocks, dead *Juncus* rushes or reeds, but nests can sometimes be up to 4m above ground in willow (*Salix*), alder (*Alnus*) or other bushes.

Baillie *et al* (2010): Since a rapid decline in the 1970s reed bunting populations have remained stable and a recent increase indicated by the BTO/JNCC/RSPB Breeding Bird Survey (BBS) has resulted in reed bunting moving from the red to the amber list of birds of conservation concern (Eaton *et al* 2009). The BTO Waterways Bird Survey and Waterways Breeding Bird Survey (WBS/WBBS) joint trends, which focus only on waterways habitats, do not show the same recent increase in numbers, however. Declines have been put down to decreased over-winter survival rates due to changes in farming practices (Peach *et al* 1999), with the recent upward trend suggesting a contraction back to core non-riverine wetland habitats following an earlier spread into farmland, but an increase in nest losses at the egg stage appears to have slowed the recovery.

Kent (1964) used questionnaires for birdwatchers to compare reed bunting and Yellowhammer, *Emberiza citrinella*, breeding habitat overlap in the Trent area, Nottinghamshire. He found greater overlap than expected from historical records and concluded that reed bunting had moved to breeding in drier habitats than previously.

Brickle and Peach (2004) studied reed bunting breeding in the Trent Valley, Nottinghamshire, finding 152 nests on farmland and in wetland habitat (mainly alongside gravel pits). 73% of nests were found in rank or emergent vegetation and this habitat was preferred to farmland habitat, which was readily available. Rank vegetation, at 30% of land within 100m of nests, was the most common habitat whilst cereal and oilseed rape combined accounted for 23%, and set-aside 15% of land around the nests. Chick faeces contained 10% plant matter, while of the invertebrate remains more than 40% was of caterpillars, 29% of spiders and 15% of beetles.

Gregory and Baillie (1998) looked at large scale habitat use across Britain using BBS data. Densities were estimated for broad habitat types leading to population estimates in those habitats. 51% of the total breeding reed bunting population was on farmland, 25% on semi-natural grassland (water meadow and grazing marsh) and 12% in freshwater sites, including rivers. However, average densities were highest at freshwater sites with around 10 birds km⁻², 5 in semi-natural grassland and around 2 in grass/till, till and scrub.

Burton *et al* (1999): Bird surveys and nest observations over 4 years on agricultural land in Lincolnshire show that oilseed rape, *Brassica napus*, was preferred as a breeding site by reed buntings to other crops and farmland habitats including grass around dykes, indicating that it may have been an important new breeding habitat for a declining bird, at least during the late 1990s.

Gruar *et al* (2006) conducted a nesting and foraging study in Nottinghamshire assessing the numbers of territorial males. Oilseed Rape was the preferred breeding season habitat for reed buntings on arable farmland and reduced this species' dependence on wet features. Birds commonly nested over 100m away from the nearest water in oilseed rape fields, whilst in other crops proximity to water was much more important. Reed buntings also forage in oilseed rape and this paper concluded that this is one of the most important breeding season habitats in lowland Britain for this species.

Vaughan *et al* (2007) ran regression models of WBBS bird data and data from the Environment Agency River Habitat Survey. Results showed good correlation between reed bunting distribution and the habitat data, with odds ratios greater than 1 (indicating a preference for higher values) for bank vegetation complexity, emergent vegetation and the presence of wetlands.

Rushton *et al* (1994) looked at 1982 WBS data on birds in England, Scotland, Wales and Northern Ireland with water quality for England from National Waterways Board for 1980. Water quality measured 1 (good) to 5 (bad) and a single-variable linear model was fitted; reed bunting count showed significant positive parameter estimates for 2 and 3, i.e. fairly good to medium. Derived detrended correspondence analysis (DCA) axes from a number of habitat variables were also considered, the more significant of which being roughly equivalent to the difference between vegetated lowland and less-well vegetated upland habitat, with reed bunting showing a significant tendency towards lowland habitat. A second axis indicating the differences between slow and fast-flowing rivers had no significant relationship with reed bunting count. Rushton *et al* defined a 'small lowland corridor' group of birds

that were more abundant on rivers with low water quality and included reed bunting in this group, but the results from the models supported the grouping only for reed warbler, *Acrocephalus scirpaceus*, and Whitethroat, *Sylvia communis*, not for reed bunting.

Surmacki (2004) studied habitat use by reed buntings in agricultural land in Poland and found that they only occupied wet marginal habitats, concluding that the conservation of these habitats plays a key role on intensively farmed land.

Pasinelli *et al* (2008) found no difference in parameters for reproductive performance and local recruitment to a colour-ringed population of reed bunting between 18 wetland patches of varying sizes in Switzerland.

Campbell (1988) conducted a before-after study using WBS mapping methods of bird populations focusing on a river engineering scheme on the Great Ouse, Bedfordshire. Work involved river dredging, the inclusion of a new weir and regrading of some bank habitat. There was little change in number of reed bunting territories (a maximum of 7 territories in each of 2 sections) despite the fact that habitat had changed with less fringing vegetation after the works. At the same time coot and moorhen populations changed significantly due to the removal of scrub and bush vegetation.

Raven (1986) studied the bird community after severe disturbance to the River Roding in Essex due to flood-alleviation works involving a 2-stage channel construction. Reed bunting territories increased over 3 years post-disturbance from 3 to 8 as fringing vegetation returned, indicating that the population had suffered due to the initial habitat change.

Discussion

The status of reed bunting in the UK and dependence on riparian habitat

It is clear from experience, backed up by the published data, that reed bunting is not a bird that depends solely on riparian habitats. Indeed, in Britain it is estimated that only 12% of the breeding population is located in fresh water habitats, although densities here are twice those in semi-natural grassland and five times that in tilled agricultural land (Gregory and Baillie 1998). There was a decline in population in the 1970s, due to reduced overwinter survival rates, a time of year when reed bunting is more dependent on drier habitats (Peach *et al* 1999), and populations have only recently started to recover, allowing it to be reclassified from the red to the amber list of birds of conservation concern (Eaton *et al* 2009), although it is still the subject of a UK Biodiversity Action Plan (BAP; UK Biodiversity Group 1998). This recovery may have been slowed due to an increase in nest loss at the egg stage (Baillie *et al* 2010), which could indicate that the quality of breeding habitat may still be important in ensuring future population increases. It has been noted, however, that this species has probably moved towards drier breeding habitats during the last century (Kent 1964) and the expansion of oilseed rape in the arable landscape has provided an important new breeding and foraging habitat which results in birds being less-dependent on wet habitats than previously (Burton *et al* 1999; Gruar *et al* 2006). The above data certainly suggest that for the species' status in the UK, changes in riparian habitats are not necessarily a driving factor, but this does not preclude the possibility that birds which nest in riverside habitat do so with a preference for river habitat of good quality or that good quality habitat results in higher nesting success and productivity than poor quality habitat.

Reed bunting breeding and riparian habitat quality

Most of the studies on reed bunting breeding in wetland habitats have been conducted in fringing vegetation alongside still or standing water, such as gravel pits (e.g. Brickle and Peach 2004), lakes and ponds (e.g. Sayers 2000) and wet grassland (e.g. Crowle 1992). These emphasise the importance of emergent vegetation such as *Phragmites* reeds, backing up the information provided by Cramp *et al* (1994). Sayers (2000) also notes that a high density of low trees alongside water indicates areas with high occurrence of reed bunting at a site in Gloucestershire. A study using the BTO's WBS/WBBS survey data indicates that complex bank vegetation and emergent vegetation are also important habitat features along riversides (Vaughan *et al* 2007). Disturbances to riverside habitat such as dredging, reed-clearance, bush clearance or pollution may, therefore, reduce habitat quality for reed bunting, altering the fringing vegetation through changes in channelling and water flow, direct habitat removal or changes in nutrient availability.

Water quality is one aspect of habitat quality which may have an effect on reed bunting populations. Pollutants may affect vegetation structure and the availability of invertebrate prey, with the possibility of both a decrease in riverside vegetation density or an increase if, for example, eutrophication results from raised nutrient levels suitable to reed growth. Eutrophication has also been cited as potentially increasing food sources for some birds (Pretty *et al* 2003). The creation of fringing vegetation to reduce nutrient run-off in an otherwise disturbed riparian habitat passing through agricultural land has been shown to provide breeding habitat for reed bunting (Stoate 2003), thus indicating a resilience to certain levels of nitrate and phosphate pollution, but although Rushton *et al* (1994) found evidence for an increased occurrence of reed bunting where water quality was neither very good nor very poor, the population response to water quality is likely to be complex and involve a number of factors, including nesting habitat, foraging habitat and invertebrate food availability. The available evidence is insufficient to give a definitive answer to what these effects might be.

Changes to water flow and channelling due to disturbance and engineering works could also, potentially, change habitat availability and prey density. Reed and other emergent vegetation is able to take hold in rivers with a slower flow, which are therefore beneficial to reed bunting populations (Rushton *et al* 1994) and there is some evidence that the presence of meanders can positively influence the abundance of invertebrates and the birds which feed on them, although the bird community in question was present in woodland and did not include reed bunting (Iwata *et al*. 2003). Again, however, detailed studies on this subject are lacking for reed bunting within the more open habitats along riversides that it prefers.

The diet of breeding reed buntings could indicate whether they are likely to depend on a diverse riverside ecosystem which could suggest a dependence on good-quality habitat. A large number of invertebrate orders and families are known to make up the diet of both adults and nestlings throughout the breeding season, although there tend to be peaks throughout the season dependent on peaks in particular orders/families of invertebrates (Cramp *et al* 1994). This could indicate that a poor-quality, low-diversity habitat may provide insufficient food throughout the breeding season for high breeding success if any of the orders relied on during certain months are absent or rare, although without quantitative data, which Cramp *et al* do not provide, this is speculation. Brickle and Peach (2004) noted a very high dependence on two orders of invertebrates, spiders and Lepidoptera larvae, in nestling diet

alongside gravel pits in Nottinghamshire, indicating that changes in food supply have the potential to seriously affect nestling diet composition and leave adults reliant on locating alternative invertebrate prey. The literature review did not reveal any studies comparing the diet of reed buntings in habitats of different quality.

Evidence for the impacts of disturbance to riverine habitats and changes in river habitat quality on reed bunting breeding populations does not appear to be common in the peer-reviewed literature and that which does exist is inconclusive. Campbell (1988) documented little change in reed bunting territories before and after major engineering works on a stretch of river in Bedfordshire whereas Raven (1986) describes the apparent recovery of a reed bunting breeding population after flood alleviation works involving major changes to the channel on a river in Essex. Both of these two studies describe changes to small populations of reed bunting, over periods of between 3 and 4 years only, so the possibility that the results merely reflect stochastic patterns is large and the power to detect population changes resulting from changes to habitat quality is small. However, the apparent resilience of the reed bunting population after major works in Bedfordshire does provide evidence that the presence of reed bunting does not automatically indicate a river in a pristine state. Evidence from non-riverine wetlands also suggests that reed bunting is not dependent on large patches of suitable breeding habitat and so may be able to maintain a population after habitat fragmentation (Pasinelli *et al* 2008) although there appear to be increased nest-losses closer to water-side reed edge than further towards dry land (Schiegg *et al* 2007) which could indicate that very small patches of habitat may not provide suitable breeding conditions.

Conclusion and Recommendation

Despite a general paucity of peer-reviewed evidence from studies comparing reed bunting populations and productivity from good and poor riverine habitat across the UK, there is much evidence to show that rivers themselves provide only a fraction, albeit a productive fraction, of the total reed bunting breeding habitat. Given the ability of this species to occupy a wide range of habitats, it is very likely that they can breed successfully in a range of riverine habitats where suitable nesting sites occur and where sufficient invertebrate food is present, which may include adjoining habitats such as grassland and agricultural land that is independent of the quality of the riverine habitat. What evidence there is does not indicate that reed bunting is eradicated when river habitat quality is compromised, even involving fairly dramatic changes to the habitat, and this backs up anecdotal evidence from ornithologists and bird watchers. On the other hand, rivers do appear to provide a productive habitat for reed bunting and its presence is likely to indicate the presence of a complex bank vegetation structure as well as emergent vegetation which could host a diverse riverside ecosystem. For the reasons listed above, the BTO opinion is that the evidence does not support the assumption that breeding reed buntings rely on good quality river habitat, but that the requirements of the species when breeding alongside rivers mean that it might still benefit from good river habitat. It is recommended that it should be moved from the A to the B list of species that qualify riverine habitat as “good quality”.

Acknowledgements

Thanks to Gavin Siriwardena, Niall Burton, Dave Leech and Robert Prys-Jones for advise on published reed bunting research. Gavin Siriwardena commented on an earlier version of this report.

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