Conservation Priority Species

The decline of the Ring Ouzel in Britain

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Abstract The Ring Ouzel *Turdus torquatus* is a Red-listed, UK Biodiversity Action Plan priority species in Britain because of steep declines in breeding numbers over the past 25 years. Data from several monitoring projects, from across much of the species' British range, show that widespread declines continue. Recent studies aimed at understanding these declines are reviewed, and suggest that low first-year, and possibly adult, survival may be the main demographic mechanism driving the decline. The research priorities are now to identify the factors affecting survival, determine where these factors are operating, and find management solutions.

The Ring Ouzel *Turdus torquatus* breeds in mountainous regions throughout Europe, and in southwest Asia. Three races are recognised: nominate *torquatus* breeds in Britain & Ireland and Fennoscandia, and winters in southern Spain and northwest Africa, especially in the Atlas Mountains of Morocco and Algeria; the central and southern European race *T. t. alpestris* breeds in central and southern Europe and winters in the south of the breeding range or in northwest Africa, thus largely overlapping with the winter range of nominate *torquatus*; and the eastern race *T. t. amicorum* breeds in the mountains of southwest Asia, east to northern Iran, and is thought to winter in Iran and southern Turkmenistan (Cramp 1988; Janiga & Poxton 1997).

In Britain the Ring Ouzel is primarily a bird of the uplands, breeding mainly in steep-sided valleys, on crags and in gullies, from near sea level in the far north of Scotland up to 1,200 m in the Cairngorms (Cramp 1988; Gibbons *et al.* 1993; Rollie 2007). The breeding season stretches from mid April to mid July; pairs commonly rear two broods, and nests are located on or close to the ground, in vegetation (typically Heather *Calluna vulgaris*), in a crevice or, rarely, in a tree. Mean clutch size is 3.9–4.2 and mean fledged brood size is 3.5–3.8. Young are fed an invertebrate diet consisting mainly of earthworms (Lumbricidae), leatherjacket (Tipulidae) larvae and beetles (both adults and larvae) (Flegg & Glue 1975; Durman 1977; Poxton 1986; Appleyard 1994; Tyler & Green 1994; Arthur & White 2001; Burfield 2002a; Sim *et al.* 2008).

Between July and September, when adults undergo a complete post-breeding moult, and juveniles a partial moult, before they migrate, the diet is dominated by berries such as Bilberry *Vaccinium myrtillus*, Crowberry *Empetrum nigrum* and Rowan *Sorbus aucuparia* (Cramp 1988). Most British breeders have departed by late September, and reach the wintering grounds from mid October onwards. Winter diet is apparently dominated by Juniper berries, especially those of Prickly Juniper *Juniperus oxycedrus* and Phoenician Juniper *J. phoenicea* (Arthur *et al.* 2000; Ellis 2003; Ryall & Briggs 2006), although Zamora (1990) confirmed that arthropods supplement the diet in Spain. The birds return north from late February (Cramp 1988).

Breeding populations in Fennoscandia and central and southern Europe are generally considered to be stable, but comprehensive monitoring data are lacking in many areas (Tucker & Heath 1994; Janiga & Poxton 1997; BirdLife International 2004). However, in parts of Switzerland, recent range contraction to higher altitudes has been recorded and this has been linked to warmer summers (Schmid *et al.* 1998; Mattes *et al.* 2005). This trend is predicted to continue, with a climate-induced decrease in suitable habitat shifting the predicted range of the Ring Ouzel by up to 440 m higher by 2070 (von dem Bussche *et al.* 2008).

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118. Male Ring Ouzel *Turdus torquatus*, Cairngorms, May 2006.

The British breeding population of Ring Ouzels has been in long-term decline, however. In the nineteenth century the species was widespread, with breeding records as far north as Orkney and perhaps as far south as Surrey, Kent and Essex (Holloway 1996). The decline appears to have begun in the twentieth century, and Baxter & Rintoul (1953) reported

large decreases in parts of Scotland between 1900 and 1950. A 27% reduction in the British breeding range was apparent between the 1968–72 and 1988–91 national atlases (Sharrock 1976; Gibbons *et al.* 1993), and these more recent losses of range were particularly marked in Scotland and Wales. The first national survey, in 1999, estimated the UK population at 6,157–7,549 pairs, with further range contraction and a probable 58% decline in population size since 1988–91 (Wotton *et al.* 2002). This led to the Ring Ouzel being Red-listed (owing to a decline of more than 50% over 25 years), and made a priority Biodiversity Action Plan species, in the UK (Gregory *et al.* 2002; www.ukbap.org.uk).

In this paper we first examine population trend data from a number of monitoring projects from across the species' British breeding range (fig. 1) to determine its current regional status, and whether there is evidence of any broad geographical variation in the observed trends. Second, we review the evidence for the causes of regional declines in Britain and identify priorities for future research to enable effective conservation measures to be implemented.

Fig. 1. Location of Ring Ouzel *Turdus torquatus* study areas in Britain.

Recent population trends

Surveys in the different study areas (fig. 1) were carried out mainly by members of the Ring Ouzel Study Group (www.ringouzel.info), which promotes co-ordinated research and monitoring of Ring Ouzels in Britain. This helped to ensure consistency in the survey methods used, with only minor variations among the different study areas. Thus, in each year of coverage, each area was surveyed at least twice between mid April and the end of June. This involved walking slowly through the study area, usually on transects about 200 m apart, recording the number of territorial pairs (based upon nest-building activity, nests located, recently fledged young, pairs seen or territorial behaviour observed on more than one visit, and/or agitated behaviour consistent with an occupied nest). Surveys were not carried out during heavy rain or in strong winds.

In Glen Clunie, Glen Effock, Glen Esk, the North York Moors and the Forest of Bowland, surveys were carried out approximately every two weeks, as part of more intensive studies of breeding biology. Ring Ouzel song was played regularly (to elicit a response from territorial males) in Wales and the Northwest Highlands, to ensure comparability with the 1999 national survey (Wotton *et al.* 2002), which provided the baseline data in these areas. The different studies varied in the frequency of coverage during the respective study periods, ranging from some with annual (or near-annual) coverage to those providing two 'snapshots' only. The period covered by different studies also varied, extending across 27 years in Dartmoor but only six years in Glen Effock.

The survey results show that declines were widespread and serious, with 13 of the 14 study areas showing a reduction in numbers (figs. 2 & 3). This included 11 areas in which the decline exceeded 50% (over periods of 7–27 years), and two in which the populations declined to extinction.

Ring Ouzel numbers in ten tetrads (2 km x 2 km squares) in the Northwest Highlands declined by 70% during 1999–2007, and by

83% in Glen Callater during 1998–2007. Three hill ranges (Lammermuirs, Moorfoots and Pentlands) in southeast Scotland showed declines of around 50% during 1985–2006, and numbers in 26 tetrads in Wales declined by 69% during 1999–2006. The Exmoor population declined from 13 pairs in 1993 to extinction in 2003–05, and numbers on Dartmoor fell by 63% during 1979–2006 (fig. 2).

The Glen Clunie population declined by 67% during 1999–2009. In Glen Esk numbers fell by 41% during 1992–2009, but in the neighbouring Glen Effock they increased by 88% during 2002–08. There was a population decline of 44% in Rosedale, North York Moors, during 2002–09, and the Long Mynd population declined from 16 pairs in 1995 to extinction in 2004–09. Finally, in the Forest of Bowland, numbers declined by 68% during 1995–2009 (fig. 3).

We compared the proportional decline between the Scottish Highlands (Northwest Highlands, Glen Clunie, Glen Callater, Glen Esk and Glen Effock), southeast Scotland and northern England combined (Lammermuirs, Moorfoots, Pentlands, Forest of Bowland and North York Moors) and more southwest locations (Dartmoor, Exmoor, Long Mynd and Wales). However, there was no evidence for any significant geographical variation ($F_{2,9} = 0.39$, $P = 0.68$).

The reasons for the population increase in Glen Effock are unknown, but may be linked to a recent rise in sheep grazing, which has increased the area of short grass (M. Nicoll pers. obs.), the favoured foraging habitat for Ring Ouzels during the nestling period (Burfield 2002a). Continued monitoring to determine future trends at Glen Effock, together with studies to identify the respective roles of survival, breeding success and immigration of breeding birds, is vital. Site-specific factors may also influence trends at some of the other study areas. For example, decreases in sheep grazing have been noted in Glen Esk (with an expected reduction in areas of short grass), while the decline to extinction of the small and isolated Long Mynd population was associated with increased nest predation (Smith 2006). However, the widespread and near-consistent steep declines that have been recorded in most areas strongly suggest that large-scale factors are affecting the British Ring Ouzel population and driving the observed national population decline.

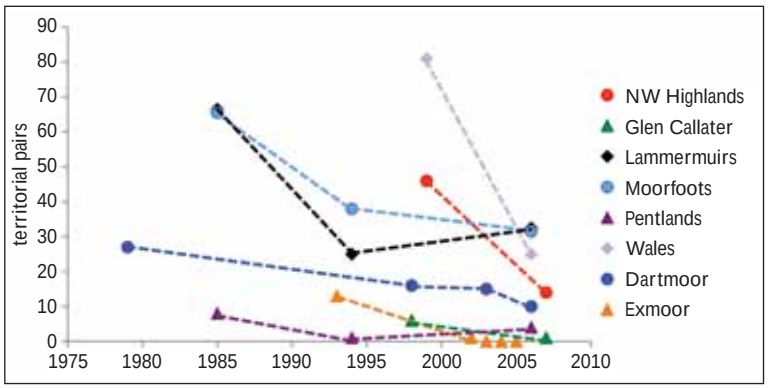

Fig. 2. Trends in Ring Ouzel *Turdus torquatus* numbers in Britain from periodic repeat surveys.

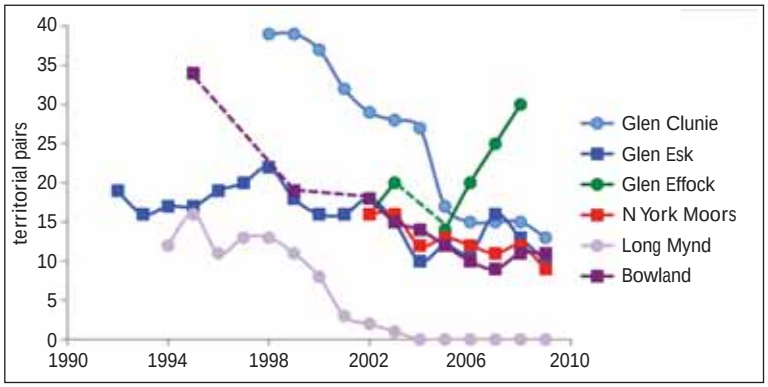

Fig. 3. Trends in Ring Ouzel *Turdus torquatus* numbers from study areas in Britain surveyed regularly in recent years. Broken lines indicate missing data from some years.

Research into causes of declines

A number of possible causes have been suggested to explain the decline of the British Ring Ouzel population but, until recently, little evidence has been available to assess which of these may be relevant, and at which stage of the life-cycle they may be operating. However, over the last decade a number of detailed studies have added considerably to our knowledge of Ring Ouzel ecology, habitat requirements and population dynamics.

Two studies have examined factors associated with declines in breeding abundance, or the desertion of historically occupied breeding sites. First, analyses of data from across Scotland found that Ring Ouzels had contracted to steeper areas within an altitudinal range of 350–750 m, and away from coniferous forests and any associated potential impacts on adjacent moorlands (e.g. decreased grazing pressure on adjacent open ground, increased numbers of potential predators using the forests as cover and population fragmentation; Buchanan *et al.* 2003). Second, long-term data on the occupation of breeding sites in the Moorfoot Hills, between 1952–85 and 1998–2000, found that site desertion was more likely at lower altitudes and where there was now lower Heather cover within both 200 m and 450 m of former nesting sites (Sim *et al.* 2007). In addition, the currently occupied nesting sites in the Moorfoots were more likely to have Heather or a Heather/grass mosaic within 100 m than were topographically suitable, but unoccupied, potential nesting sites.

Together, these studies show that Ring Ouzel breeding distribution has contracted to sites at higher altitudes, with greater Heather cover and away from conifer plantations. They do not demonstrate whether such relationships are causal (for example, whether lower Heather cover around nests affects breeding success, or climate change is causing low-altitude sites to become unsuitable), or whether they simply reflect a contraction to preferred areas as the population declines because of other, unrelated, causes (such as reduced overwinter survival). However, declines have also been recorded in areas where Heather cover remains extensive around nesting sites and where there has been little or no afforestation (e.g. Glen Clunie, Glen Esk and Glen Callater). Further-

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119. A typical Ring Ouzel *Turdus torquatus* nest-site in Britain, this one being on a heather-covered crag in Glen Clunie in May 2008.

more, detailed studies have found that nest survival rates and overall breeding success in the Moorfoot Hills (an area with afforestation and historical declines in Heather cover) were similar to those in other areas where there has been little change in these aspects of the habitat (e.g. Glen Esk and Glen Clunie; Burfield 2002a; Sim *et al.* in prep.). Therefore, while such land-use changes have undoubtedly contributed to declines in some areas, they seem unlikely to be the major factor driving the overall declines.

Another study investigated climate correlates of Ring Ouzel breeding success and population trends in northern Britain, to assess possible links between population decline and climate change (Beale *et al.* 2006). Population declines in the Moorfoot Hills followed years when British summer (June–August) weather was warm and moderately wet, and when spring rainfall in Morocco 24 months previously was high (suppressing Juniper flowering, and thus reducing berry production, with possible adverse consequences for subsequent overwinter survival of Ring Ouzels). Based upon the recent trends in these three weather variables, these relationships suggested that increases in British summer temperatures may be driving Ring Ouzel population declines, possibly through causing drier soil conditions, hence reducing earthworm availability, at the end of the breeding season and during the post-fledging period (Beale *et al.* 2006).

However, preliminary findings from studies in 2007–08 on the foraging behaviour and survival of radio-tagged Ring Ouzel fledglings at Glen Clunie (Sim *et al.* in prep.) provide little evidence for unusually low survival during the post-fledging period. Indeed, Ring Ouzel survival rates there appear to compare favourably with those of similar-sized passerines in Britain and the USA (Anders *et al.* 1997; Robinson *et al.* 2004; White *et al.* 2005; King *et al.* 2006; Schmidt *et al.* 2008). In addition, there was no evidence for any seasonal decline in either earthworm abundance or soil moisture levels, although 2007 was a very wet year and 2008 a fairly dry one. However, this study covered only two summers, and a longer run of data would be required to assess how local, national and global climatic variables may influence local Ring Ouzel productivity and survival.

Long-term studies of breeding success and survival rates in declining populations can provide valuable insights into, and under-

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120. Brood of four Ring Ouzels *Turdus torquatus* in a nest in Glen Clunie, July 2009.

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121. Wintering habitat for British Ring Ouzels *Turdus torquatus*: the juniper-clad slopes of the Atlas Mountains in Morocco.

standing of, the causes of decline. Such work has been undertaken in a joint Grampian Ringing Group/RSPB project on Ring Ouzels in Glen Clunie during 1998–2009. This glen was known to hold a relatively high-density population that was stable between 1991 and 1998 (Rebecca 2001), but which subsequently declined markedly during 1998–2009 (fig. 3). Over this period, changes in some aspects of breeding success have been detected (e.g. reduced mean brood size of first nests at fledging, from 3.8 to 3.4, owing to decreased nestling survival). However, this effect has been offset by a small increase in nest survival rate, so that there has been no decline in overall reproductive success (Sim *et al.* in prep.).

Preliminary analyses of adult survival of Ring Ouzels in Glen Clunie suggest that it was low compared with similar species in Britain and North America (Savidge & Davis 1974; Nichols *et al.* 1981; Roth & Johnson 1993; Siriwardena *et al.* 1998; Porneluzi & Faaborg 1999; Bayne & Hobson 2002; Gardali *et al.* 2003). Although adult Ring Ouzel survival did not decline during the course of the study, return rates of first-year birds *did* decline, though whether this reflected higher mortality, higher dispersal away from the natal areas, or both, is unknown. Since adult survival appears to be low compared with similar species, and given that population modelling (elasticity analysis) indicates that population growth rate is particularly sensitive to variation in first-year survival, this suggests that low survival may be a key driver of Ring Ouzel declines (Sim *et al.* in prep.). It is therefore important to identify the causes of poor survival.

As a migrant, the Ring Ouzel is affected by factors acting on the breeding grounds, in overwintering areas and during migration, and this adds to the difficulties of identifying the causes of low survival. An analysis of the number of Ring Ouzel bird-days at British and Irish bird observatories in spring during 1970–98 found that numbers passing through western observatories (assumed to be mainly British breeding birds) declined significantly, whereas numbers passing through east-coast observatories (assumed to be mainly Fennoscandian breeders) did not (Burfield & Brooke 2005). If these assumptions are correct, this suggests that the causes of low survival could occur on the breeding grounds or on migration, because British and Fennoscandian birds have overlapping wintering ranges (Burfield 2002b); individuals of

both subspecies have been trapped at the same time and in the same nets in Morocco (Ellis 2003).

The expected difference in migration route and timings of the two populations could expose them to different risks. In particular, although hunting of other thrush species is permitted under the Birds Directive in certain EU countries, particularly in the Mediterranean, the Ring Ouzel is not a legal quarry in any member state (OJEU 2010). However, there is a real risk that Ring Ouzels may be confused with other thrushes by hunters and shot in error. In general, the hunting season in France ends on 10th February but a number of species (including thrushes) may be legally hunted in some southern departments until 20th February (JORF 2009). Consequently, British-breeding Ring Ouzels passing through France earlier than Fennoscandian breeders in spring may be exposed to greater mortality risks from hunting. Furthermore, in autumn, British breeders probably migrate through France on a more westerly route than Fennoscandian breeders and are more likely to pass through southwest France, where ringing recoveries show that hunting pressure is particularly intense (Burfield 2001).

Few studies of Ring Ouzels have been undertaken in their wintering areas, but in southern Spain the berries of Common *J. communis* and Phoenician Juniper were the most frequent food items (Zamora 1990; Jordano 1993). However, in Morocco's Atlas Mountains, Phoenician (and to a lesser extent Prickly) Juniper berries were considered the most frequent food items (Arthur *et al.* 2000; Ellis 2003). Ryall & Briggs (2006) confirmed this preference for Phoenician Juniper, and noted that the Juniper woodlands used by Ring Ouzels were in a degraded and ageing state. Damage to trees from cutting, indicative of general levels of disturbance, appeared to be a stronger determinant of Ring Ouzel presence than did the number of berries (Ryall & Briggs 2006). In addition, Beale *et al.* (2006) provided some evidence that food availability in the wintering areas may affect survival, linking population declines in the Moorfoot Hills to levels of rainfall in the wintering areas (and hence Juniper berry abundance – see above).

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122. Male Ring Ouzel *Turdus torquatus*, Cairngorms, May 2006.

Future research priorities

Research to date has identified a number of factors that may be involved in causing the decline of the British Ring Ouzel population, but suggests that low first-year, and possibly

adult, survival may be the critical demographic parameter driving this decline. The causes of low survival and whether these are operating on the breeding or wintering grounds, or on migration routes, remain unknown. Research that examines the factors affecting survival at all of these stages of the life-cycle is now urgently required. Designing and undertaking studies that measure survival during each of these stages, and which identify the main causes of mortality, represents a major challenge. However, recent advances in the miniaturisation of tracking devices, most notably geolocators (Fiedler 2009), mean that it is now possible to track birds the size of a Ring Ouzel through the full annual cycle, and this increases the feasibility of identifying the timing of migration and the location of the main stopover and wintering sites.

Further work should also be encouraged on the British breeding grounds, to test experimentally the effect of habitat and management manipulations on breeding success and survival. Effective monitoring of the British breeding population remains challenging, with coverage by the Breeding Bird Survey (BBS) being inadequate to detect national trends. Recent increases in BBS coverage within the English uplands will help to improve this situation considerably, but the majority of the British population will remain poorly covered. However, the second national Ring Ouzel survey, scheduled for 2011, should provide information on national and regional population trends, and the results of the 2007–11 Atlas will shed light on changes in distribution.

Outside Britain, further studies of Ring Ouzel ecology in the wintering areas would be valuable. Studies to establish the full wintering range of the British breeding population, and the extent and drivers (e.g. agriculture, development, drought, demand for firewood) of change in Juniper woodlands within this area will help to determine whether winter food supplies may be a critical issue. Determining whether large numbers of British birds are being killed on migration through France and Spain would similarly provide initial indications as to the role of hunting mortality. Finally, there is a need to improve our knowledge of trends and, where relevant, the causes of declines in other European breeding populations. Many of these are very poorly studied and the trend data available are qualitative or semi-quantitative at best (Tucker & Heath 1994; Janiga & Poxton 1997; BirdLife International 2004). Priority countries for improved monitoring should include those with the largest populations (e.g. Romania, Austria, Norway and Russia) and those at the southern limit of the range and thus most vulnerable to climate change (e.g. Spain, Italy and Turkey).

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Atlas 2007–11 update

At the halfway stage of breeding-season fieldwork for Bird Atlas 2007–11, a provisional map showing the distribution of the Ring Ouzel is available. The level of breeding evidence recorded so far is shown by the size of the dot, which indicates possible (small), probable (medium) and confirmed (large) breeding. Fieldwork in April–July 2008 and 2009 covered much of the core range of the Ring Ouzel, although some remote or difficult-to-access 10-km squares may not have been visited yet. Compared with the 1988–91 Breeding Atlas, the provisional map suggests further range contraction across all breeding areas in Britain & Ireland. If you have any records from 2008 or 2009 not shown here, please submit them as soon as possible. Fieldwork for the third breeding season started on 1st April and all records of Ring Ouzels in breeding habitat are welcomed. Records can be submitted online at www.birdatlas.net or by requesting paper forms from the BTO (tel. 01842 750050).