Are winter species composition and abundance censuses of birds in small urban green areas comparable?

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Abstract. Wintering birds were studied in three plots (10.0–14.5 ha) in urban green areas in central Poland. Two observers independently counted the birds in each plot on six days evenly distributed between mid-December and mid-February. On the count day, each observer did two surveys: an early count, starting at 8 a.m., and immediately afterwards, a late count, finishing before noon. Using three-way ANOVA, the differences between densities, numbers of species and Shannon-Wiener diversity indices obtained in single counts were tested in relation to independent variables: the count time (early or late), the observer, and the plot. No effect of plot variable was revealed. An observer effect was, however, found in the number of species, as well as in the densities of the whole avifauna and of flocking species. Differences in the bird diversity indices were found only between the early and late counts. The results of the present study indicate that there are no means of definitively assessing the number of species, density, and species diversity of birds wintering in small parts of urban green areas.

Key words: bird census method, wintering birds, urban birds, Parus, Corvus, mixed species flocks

Received — July 2005, accepted — Dec. 2006

INTRODUCTION

One of the basic problems in studies on species composition and numbers of birds is comparability of results. Results of such studies obtained even by the same methods but by different observers are often biased due to a number of reasons. One source of error, difficult to estimate, results from differences in experience, habits and perceptiveness of each investigator (Källander et al. 1977, T omiałojć 1992, Rosenstock et al. 2002). Even when the results come from the same observer, obtaining comparable quantitative data may be difficult. In studies of winter avifauna, two main problems influence comparability of results. The first type relates to difficulties in determination of the real number of birds in the field, caused by high mobility of some species (e.g. Nilsson 1974, T omiałojć 1974, Brewer 1978, Donald et al. 1997). The second problem stems from temporal changes of species composition and numbers of birds in small areas taking place during the course of winter (e.g. Källander et al. 1977, Jokimäki & Suhonen 1998). These factors may lead to significant differences found in species composition and bird numbers in winter in the same area by the same method.

Papers addressing effects of the problems listed above on results of studies on winter avifauna are scarce. The influence of the number of counts performed in winter on abundance estimates of some species and on the estimates of species richness has been described by several authors (Luniak 1981, Biaduń 1994, Nowakowski & Dulisz 2001, Brauze & Zieliński 2004). In a few papers only (Robbins 1970, Nilsson 1974, Robbins & Bystrak 1974, Källander et al. 1977, Brewer 1978) the applicability of methods has been presented, while Jokimäki & Suhonen (1998) defined detectability and changes in numbers of some species in winter for the single-visit plot method. The goal of the present paper is to determine if potential changes in species composition and bird numbers, difficulties in counting them...
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The World Meteorological Organization (WMO) has reported that the 1990s were, globally, the warmest decade since instrumental measurement started in the 1860s and that the ten warmest years on record have all occurred since 1983. In recent years there has been a growing literature on analyses of bird migration phenology from countries as diverse as France (Sueur & Triplet 2001), Russia (Sokolov et al. 1998), and the USA (e.g. Butler 2003). Lehikoinen et al. (2004) summarised available data on European migration phenology and concluded that about 40% of first arrival series were getting significantly earlier but only 2% significantly later. A changing phenology has proved to be important in demonstrating effects of rising temperatures on the natural world, but, with a few exceptions, has largely unknown consequences on population dynamics and distributions. Because of its relative abundance and longevity, data on migration phenology are frequently examined for evidence of climate impacts.

In the UK there are many phenological data collected by a range of different interest groups ranging from individual ornithologists, through Bird Clubs to coastal bird observatories. Portland Bird Observatory is located on the southern coast of England on a headland (Portland Bill) extending nine km into the sea. As a point of entry, it is therefore uniquely placed to examine the effects of temperatures further south on migration into the UK. The bird observatory at Portland has been running for several decades and comprehensive records are available for all years from 1959 onwards. A comparison with two other observatories using data up to 1998 was included in Loxton & Sparks (1999). In this paper we extend the data up to 2005 and examine for changing trends in arrival phenology and the influence of temperatures on the European part of the migration routes.
**INTRODUCTION**

In much of the species Eurasian and North African breeding range, the House Martin is common and numerous (Cramp 1988, Turner & Rose 1989, Snow & Perrins 1998, Seriot & Alves 2002). In spite of this, very little is known about its breeding biology in the southern part of the geographical area (Møller 1984). Most detailed studies on different aspects of the breeding biology of House Martins were conducted in Britain (Bryant 1975, 1978a, 1978b) central part of Europe (Hund & Prinzinger 1979, Rheinwald 1979, Pikula & Beklova 1987) and North-East Europe (Lind 1960, Lyuleeva 1974). Most southerly situated populations have been studied in Extremadura, Spain (Pajuelo et al. 1992, de Lope et al. 1993) but there is a complete lack of basic breeding data from European Mediterranean region or from North Africa (Etchecopar & Hue 1964, Seriot & Alves 2002). North African populations of House Martins seem especially interesting because they live at the southern edge of the species breeding range and, as a consequence, different environmental factors influencing life histories may be expected to reach their extreme values (Garcia & Arroyo 2001).

Having analysed the reproductive ecology of an North African population of the Barn Swallow *Hirundo rustica* Sakraoui et al. (2005) found that the breeding strategy differ in many respects from theoretical predictions concerning the geographical pattern (Lack 1947, Ashmole 1963, Møller 1984). Especially, clutch sizes proved to be larger and the number of clutches per year smaller than expected. It seemed probable that similar special features would be revealed in House Martins, as this species is also an air insect feeder, undergoing similar environmental constraint. Consequently, its breeding performance would be expected to be dependent on the productivity of aerial insects, which is sensitive to weather conditions (Bryant 1973, 1975). The hot and dry period of the breeding season typical of North Africa is a heavily limiting factor for the timing of breeding (Blondel & Aronson 1999). Because the weather differs to

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**Breeding biology of the House Martin *Delichon urbica* in Algeria**

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**Abstract.** Dates of egg laying, clutch size, the numbers of hatchlings and fledglings, and egg dimensions were studied in Annaba, Algeria in 2004–2005. The onset of laying is related to the end of the wet period and shows some inter-year variation. 38–45% of breeding pairs produce two broods per year. Mean clutch size declines with the progress of the breeding season. Mean values vary between the first (4.7 eggs) and second clutch (3.5 eggs) but not between years. Hatching and fledging success is relatively low in comparison with other Western Palearctic populations, probably because of environmental constraints operating at the southern edge of the House Martin breeding area. The relatively small size of Algerian House Martin eggs fits the general geographic pattern of variation.

**Key words:** House Martin, *Delichon urbica*, reproduction, timing, clutch size, geographic range, North Africa

Received — Sept. 2006, accepted — Nov. 2006
A nearly complete skeleton of the fossil galliform bird *Palaeortyx* from the late Oligocene of Germany

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Abstract. Phasianid galliform birds do not occur in Europe before the end of the early Oligocene, and their Paleogene fossil record mainly comprises isolated bones. Here we describe a nearly complete and articulated skeleton of a phasianid galliform bird from the late Oligocene of Enspel in Germany. The specimen is assigned to *Palaeortyx cf. gallica* Milne-Edwards, 1869 and for the first time allows the recognition of cranial and pelvic details in a late Oligocene phasianid. Many gizzard stones are preserved in both the gizzard and the crop, and constitute the earliest fossil evidence for grit use in a phasianid galliform.

Key words: fossil birds, Galliformes, *Palaeortyx*, gizzard stones, Oligocene

Received — July 2006, accepted — Oct. 2006

INTRODUCTION

As traditionally recognized (e.g. Stresemann 1927–1934), the galliform taxon Phasianidae includes the Odontophorinae (New World quails), Numidinae (guineafowl), Meleagridinae (turkeys), Tetraoninae (grouse) and the, probably paraphyletic, “Phasianinae” (Old World quails, pheasants, partridges, etc.; Kimball et al. 1999, Armstrong et al. 2001). Of these, only Tetraoninae and “Phasianinae” occur in Europe today.

Although the European fossil record of galliform birds dates back into the early Eocene (47 million years ago, Mayr 2000, 2006), all Eocene and early Oligocene galliform taxa are outside crown group Galliformes and belong to the Gallinulidae, Quercymegapodiidae, and Paraortygidae (Mourer-Chauviré 1992, Mayr 2005). Phasianidae do not occur in Europe before the end of the early Oligocene, about 30 million years ago (Mourer-Chauviré 1992), and most Oligocene phasianids belong to *Palaeortyx* Milne-Edwards, 1869. This taxon also occurs in the early Miocene of France and Germany (Göhlich & Mourer-Chauviré 2005) and has so far been known from isolated limb and pectoral girdle bones only. The only other phasianid from the Oligocene of Europe is *Schaubortyx keltica* (Eastman 1905), which is based on a rather poorly preserved disarticulated skeleton from the early Oligocene (MP 25) of France (Eastman 1905, Schaub 1945) and distinctly differs from *Palaeortyx* in its intermembral proportions (Mourer-Chauviré 1992; contra Mlíkovský 2002 who synonymized *Schaubortyx* Brodkorb, 1964 and *Palaeortyx* Milne-Edwards, 1869).

Here we describe a nearly complete and articulated skeleton of *Palaeortyx* from the late Oligocene (MP 28, Storch et al. 1996; i.e. 24.7 mya; Mertz et al. in press) maar lake deposit of Enspel near Bad Marienberg in Westerwald, Germany. It is the second avian specimen from Enspel (Mayr 2001), and one of a few articulated skeletons of Oligocene galliform birds.

MATERIAL AND METHODS

Osteological terminology follows Baumel & Witmer (1993). Measurements are in millimeters and indicate the maximum length of the bone.
Habitat and nest site selection in the Common Gull *Larus canus* in southern Poland: significance of man-made habitats for conservation of an endangered species

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**Abstract.** The Common Gull is a rare and endangered breeding species at inland habitats in Poland as well as in some other countries in Europe. Breeding biology, habitat and nest site selection were studied in this species in southern Poland. Almost all birds nested on industrial water bodies (gravel pits, sedimentation basins), although fishponds and reservoirs were the most abundant habitat in the study area. Birds built their nests mainly on islets, man-made constructions and dry land on the shores of water bodies. The islets occupied by birds were smaller and were covered by lower vegetation than the unoccupied ones. When occupied islets on industrial water bodies were compared with a random sample of islets on fishponds, the latter were found to be larger, with taller and denser vegetation. This may explain why Common Gulls did not breed on fishponds in southern Poland. Shore-breeding birds nested in open areas with sparse vegetation, occupying sites with less vegetation cover and closer to shrubs or trees than randomly selected points. Breeding performance (mean date of clutch initiation, clutch size, clutch volume, hatching success and breeding success) did not differ among nests built on islets, man-made constructions or on the shores of the water bodies. Breeding success was more than twice as high as in large riverine colonies. Industrial water bodies may become important alternative breeding habitats for this species in Poland.

**Key words:** Common Gull, *Larus canus*, habitat selection, man-made habitats, nest sites, nest size, breeding biology

Received — July 2006, accepted — Nov. 2006

**INTRODUCTION**

Habitat and nest site selection studies are essential for effective protection and management of endangered species (e.g. Morrison et al. 1998, Väli et al. 2004, Hewson et al. 2005, Wesolowski et al. 2005). Nest-site selection is one of the most important factors determining breeding success and therefore fitness in birds (Partridge 1978, Cody 1985). Birds differ in nest-site selection patterns, some species select sites secure from predators, others select sites with easy access to foraging grounds or protected from adverse weather conditions (Parsons & Chao 1983, Jehl & Mahoney 1987, Xirouchakis & Mylonas 2005, Urios & Martinez-Abrain 2006). Birds also differ in the number of nest-sites utilized, some species are nest-site specialists while others show high plasticity in nest-site choice (Newton 1998, Velando & Freire 2003, De Kroon 2004).

The Common Gull occurs in North America and Eurasia (Cramp & Simmons 1983). The gull inhabits a variety of habitats such as lakes, marshes, rivers, harbours, roofs or even fields (Wesołowski et al. 1984, Bergman 1986, Burger & Gochfeld 1987, 1988, Vermeer & DeVito 1987, Bremer 1995). Besides the range of habitats occupied, this species also shows high plasticity in nest site choice within a habitat (Wesołowski et al. 1984, Burger & Gochfeld 1987, 1988). In Poland, this
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The egg quality plays important role in avian reproduction. However, to date the majority of studies have focused on quality expressed as egg size and/or egg contents chemical composition (Blount et al. 2000). For example, egg size positively affects the reproductive output of birds, particularly, through influencing chick survival during the first days of their life (review in Williams 1994). It has been also well documented, that egg size traits are heritable and thus respond to natural selection (Hendricks 1991). However, much fewer data provide explanation for function of eggshell colour and patterning. So far, several hypotheses have been proposed (see Kilner 2006 for a review). In the past, the most common were anti-predation and anti-parasitic mechanisms which resulted in crypsis and mimetism of avian eggs respectively. Other functions like filtering solar radiation or strengthening the eggshell, has also been postulated (Moreno & Osorno 2003, Gosler et al. 2005). More recently, eggshell pattern was considered as sexually selected trait signaling female and offspring condition to mates (Moreno & Osorno 2003, Siefferman et al. 2006). This assumption has been shown in the case studies on pied flycatcher Ficedula hypoleuca (Moreno et al. 2004, Moreno et al. 2005, Soler et al. 2005).

Although egg size, shape and eggshell pattern are species specific and even serve as a clue for species identification, eggs produced by females of the same species differ slightly from each other. Understanding basis of this variation is crucial in further investigations on the role of eggshell patterning (Gosler et al. 2000). One of the methods used for analysing variation of any phenotypic traits in animals is repeatability measure. Repeatability represents the proportion of phenotypic variance due to genetic plus environmental variance (Falconer 1981). Thus, repeatability sets an upper limit for heritability. Straightforward studies on inheritance of phenotypic traits demand tracking consecutive generations of a given species what is not always possible in the field conditions (Boag & Noordwijk 1987, Bańbura & Zieliński 1990). In such situations repeatability may be used as an approximation of heritability.
Breeding ecology of Aquatic Warblers *Acrocephalus paludicola* in their key habitats in SW Belarus

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**Abstract.** The breeding ecology of the Aquatic Warbler was studied on the three largest mires in Belarus in 1998–2004. Numbers of male Aquatic Warblers on these mires range from 6370 to 11500, which is more than 50% of the species world population. In years with favorable nesting conditions breeding success on the three mires varies from 36.3% to 54.1%. In years with significant water level fluctuations and irruptions of shrew populations the breeding success decreases sharply, varying from 2.9% to 27.7%. The main reason for the mortality of eggs and nestlings was predation, probably by small insectivorous mammals. The species is well adapted to the unstable nesting conditions in fen-mires; but in years with serious flooding, high water levels throughout the nesting season, disturbances to the vegetation structure after spring fires or in years with a high density of shrews, breeding success decreases significantly.

**Key words:** Aquatic Warbler, *Acrocephalus paludicola*, breeding success, predation, shrews, mires, reedbeds, threatened species

Received — March 2006, accepted — Oct. 2006

**INTRODUCTION**

The Aquatic Warbler is a globally threatened species bound to lowland bogs and marshes. The core of the contemporary breeding range of the species is located in the Belarus and Polish “Polessye lowland”. More than 70% of the European Aquatic Warbler population inhabits only four large mire tracts in Poland and Belarus (Aquatic Warbler Conservation Team 1999).

The breeding ecology of Aquatic Warbler has been studied just on one marshland so far — the Biebrza river valley (NE Poland). Moreover, most investigations were carried out just on one monitoring plot in Poland situated in a non-flooded zone and characterized by relative stability in terms of hydrology and vegetation dynamics (Dyrcz & Zdunek 1993a, 1993b, Schulze-Hagen et al. 1999). There are reasons to believe that the breeding data obtained from only one site may not reflect neither all the peculiarities of the breeding ecology of the species nor the full range of its adaptive capacities under different environments.

Additionally, a number of recent studies in Belarus prove that fen bogs — which are the habitats of the species — are quite unstable ecosystems (Kozulin et al. 1998, 1999, Kozulin & Flade 1999, Kalinin & Obodovskiy 2003). As a consequence, density and number of the Aquatic Warbler fluctuate significantly within and between seasons. These fluctuations are influenced by a number of natural and anthropogenic factors, such as vegetation successions, water table oscillations and fires (Kozulin et al. 2004). However, the mechanisms by which these factors influence the state of the Aquatic Warbler population have not been discovered yet.

Therefore, to better understand the contemporary condition and population trends of this globally threatened species, and also to work out clear recommendations for its conservation, it is necessary to study its breeding ecology in different types of marshes. This publication presents results of a study on Aquatic Warbler breeding success in the major European nesting habitats located in SW Belarus which host ca. 50% of the global population of this species.
INTRODUCTION

Accentors are small oscine passerines typical of the Old World. All the 13 species currently identified belong to a single family, Prunellidae, and a single genus, *Prunella*. These birds all are inhabitants of Eurasian high montane biome, with the Himalayas, Tibetan plateau and central Asia as the centre of species diversity (Zheng 2002). Regarding their abundance, breeding ecology and social biology, extensive published data are available only for two species: Dunnock *Prunella modularis* and Alpine Accentor *P. collaris* (Cramp 1988, Nakamura 1995a, b). In particular, the studies of these two species revealed an interesting, unusual mating system: cooperative polygynandry (e.g. Davies 1992, Davies et al. 1995, Nakamura 1998a, 1998b). In contrast, ecological information about those taxa occurring in the evolutionary centre of the species group is very limited (Ali & Ripley 1987, Chen & Luo 1998).

The Brown Accentor is one of the high-mountain accentors. They are distributed in the Himalayas, Tibetan plateau through central Asia, occupying altitudes above 2000 m (Zheng et al. 1983, Ali & Ripley 1987, Grimmett et al. 1998). Despite the wide occurrence, little was known of their ecology and social system. In this paper, I provide such information, which was collected from the Lhasa region, Tibet.

MATERIAL AND METHODS

Study area

I studied Brown Accentors mainly in the Xiongse valley (29°27'N, 91°40'E), Lhasa, Tibet. The annual average air temperature of the study area is 4.5°C and precipitation is summer-biased, with 80% of the annual total precipitation of 566 mm falling between June and September. Vegetation is characterized by alpine shrub and meadow. Between 3980 and 4550 m a.s.l. on the south-facing slopes vegetation is dominated by Rose *Rosa sericina* and Lhasa Barberry *Berberis hemleyana* shrubs, and Wilson Juniper *Sabina pingii* shrubs extend from 4550 to 4980 m. North-facing slopes between 4200 and 5100 m are covered by...
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Any avian breeding trait is influenced by resource availability required for phenotype development and performance (Lack 1968, Martin 1987). In fast-growing avian species, raising offspring optimally requires large amounts of food. Food is not only invested in growth and reproduction, but also in maintenance and defense against potential enemies, such as pathogens (e.g. Fargallo & Merino 2004) and parasites exploiting adults and/or nestlings (Loye & Zuk 1991, Simon et al. 2004). Many seasonally breeding free-ranging birds are therefore challenged annually to match their reproductive performance with a narrow time window when food availability is at its maximum. Individuals reproducing outside this window often have lower breeding success, as expressed in the number and quality of the chicks produced (Van Balen 1973, Dias & Blondel 1996, Blondel et al. 2006).

Blue Tits produce the largest families of any nidicolous bird in the world (Perrins & McCleery 1989). The brood weight at 14 days post-hatching represents between 3–16 times the adults’ body weight, depending on the territory and study population. Blue Tit breeding time and reproductive effort most probably evolved in response to the timing of maximal caterpillar biomass supply, key prey to raise chicks (e.g. Zandt et al. 1990, Dias & Blondel 1996, Bańbura et al. 1999, Grieco 1999, Blondel et al. 2006, but see e.g. Lambrechts et al. 2004). Lower breeding success and offspring survival is found in Blue Tits raising chicks well before or after the peak date of caterpillar availability (Dias & Blondel 1996, Blondel et al. 2006). Additional observations of food delivered to chicks in combination with experiments manipulating brood size, breeding time and/or food availability support the view that caterpillar availability in the territory influences parental feeding capacities and the types of prey delivered to...
Absence of insular density inflation in Corsican Finches *Carduelis [citrinella] corsicanus*

Marc Imanuel FÖRSCHLER

The so-called insular syndrome predicts changes in morphology (distinct plumage coloration, body size), behaviour (increased niche breadth) and demography (reproductive success, clutch size, population size) between insular and mainland populations (e.g. Blondel 2000). The reduced species richness on islands is often associated with higher population densities compared to those in similar mainland habitats (e.g. Blondel 2000). These higher densities in island populations are generally explained by the relaxation of interspecific competition on islands, niche expansion, reduced predation rate, restricted dispersal and intraspecific spill-over (George 1987, Ricklefs & Lovette 1999, Blondel 2000).

Mainland Citril Finches *Carduelis citrinella* and insular Corsican (Citril) Finches *Carduelis [citrinella] corsicanus* are appropriate model organisms to study differences between islands and mainland as imposed by the insular syndrome. Citril Finches breed in the higher mountain zones of the Iberian Peninsula, Central France, the Alps and at its northern distribution edge in the Schwarzwald (Dorka 1986, Cramp & Perrins 1994, Glutz von Blotzheim & Bauer 1997). Corsican Finches are restricted to few mountainous Mediterranean islands (Moltoni 1975, Arcamone 1993, Cramp & Perrins 1994, Baccetti & Märki 1997, Thibault & Bonaccorsi 1999). Mainland Citril Finches live in more wooded areas dominated by different pine species (especially Mountain Pines *Pinus (mugo) uncinata*, *Pinus (mugo) rotundata*), while insular Corsican Finches, use mainly the open landscape dominated by Tree Heath *Erica arborea* vegetation (Förschler & Kalko 2006b). Little information has been published about population densities of these scarcely distributed rare mountain birds. I tried to fill this gap by studying population densities in “hot spot” areas across the total range of the two (sub-) species. Main aim of this work was to find out, if insular Corsican...
Sexing individuals, a prerequisite of many behavioral and ecological studies, is difficult without invasive methods in an array of bird taxa. The recent development of molecular sexing techniques using DNA markers (e.g. Griffiths et al. 1996, Ellegren & Sheldon 1997) provides a reliable non-destructive research tool. Although DNA-based genetic techniques have become common, researchers may prefer simpler methods of sexing by morphology or behavior in order to facilitate the sexing procedure (Mallory & Forbes 2005). Even in species that do not exhibit pronounced sexual dimorphism, slight differences in mensural characters, especially when combined by discriminant analysis, may help to separate the sexes. Also, many birds can be unequivocally sexed from sex-specific behavior, most often by vocalizations, courtship displays or position during copulation (Ainley et al. 1985, Casaux & Baroni 2000). Such options may be preferable when obtaining tissue samples necessary for DNA extraction is difficult or causes serious disturbance to the birds.

Problems with sex identification by morphometry and plumage are particularly true for many grebe species (family Podicipedidae). Also, in most species it is difficult to point out any behavior unique to one sex (Storer 1969, Fjeldså 1973). Progress in grebe research has been additionally hampered by lack of time-efficient, low-intrusion capture techniques. In consequence, few field studies on grebe morphometrics generally refer to birds that died on migration or wintering grounds, where unknown proportions of individuals originating from different populations may contribute to the samples (Fjeldså 1973, Piersma...
Abnormally long incubation periods have been documented in several bird species (Skutch 1962, Holcomb 1970). This behaviour occurs regularly in the Procellariiformes (e.g. Boersma & Wheelwright 1979, Chaurand & Weimerskirch 1994, Huin 1997) and occasionally in the Podicipediformes (Kloskowski 1999, Nuechterlein & Buitron 2002). It has been linked to intermittent incubation or egg-neglect, as a consequence of long foraging distances (Pefaur 1974, Boersma & Wheelwright 1979) or the avoidance of predation (Nuechterlein & Buitron 2002), respectively.

Prolonged incubation could be an adaptive mechanism, since it provides a margin of safety for eggs that take longer than usual to hatch (Holcomb 1970, Ferguson & Sealy 1983, Huin 1997). Very few cases have been documented in raptors and generally refer to anecdotal observations of eggs that are addled or infertile and the data only reflects the occurrence of this behaviour at the species level (Margalida et al. 2006a).

The Bearded Vulture is a long-lived, cliff-nesting raptor that inhabits mountain regions of the Palearctic and Afrotropical regions (Hiraldo et al. 1979). In monogamous pairs, both sexes play similar roles during the incubation period (Margalida & Bertran 2000). In polyandrous trios, the incubation is shared by the three members (Bertran & Margalida 2002). The death of the embryo due to low temperatures appears to have selected for the near constant presence of one of the adults at the nest (Brown 1990, Margalida & Bertran 2000) and, in addition, the risk of predation is very low, thus probably not important in evolutionary terms. However, human disturbance (see Arroyo & Razin 2006) can cause egg-neglect and lead to low temperatures affecting the development of the embryo. This factor, and the infertility of the eggs, can cause cases of prolonged incubation in this species.

In the case of successfully hatched clutches, there does seem to be a link between the num-

**Prolonged incubation of non-viable eggs in the Bearded Vulture *Gypaetus barbatus***

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**Abstract.** We present the frequency and duration of prolonged incubation in the Bearded Vulture and test different hypotheses on the possible adaptive significance of this behaviour. The mean and median prolonged incubation lasted 29 and 25 days respectively (n = 10), i.e., 54% and 46% respectively longer than the average incubation period. There was a negative correlation between the duration of prolonged incubation and the egg-laying date: prolonged incubation lasted longer in earlier clutches than in later ones, and territories with many breeding attempts showed short incubation prolongations. On the other hand, no correlation was found between the duration of prolonged incubation and productivity or breeding success. The results suggest that more experienced birds, which occupy higher quality territories and lay their eggs earlier, prolonged their incubation to a greater extent. Although prolonged incubation may constitute an example of adaptive behaviour, the extensive periods documented in some cases do not appear to support this assumption.

**Key words:** Bearded Vulture, *Gypaetus barbatus*, energy constraints, prolonged incubation, unhatchable eggs, birds of prey

Received — June 2006, accepted — Oct. 2006