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# Factors affecting brood patch development in Magellanic Penguins *Spheniscus magellanicus*

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**Abstract.** Brood patches allow the transfer of heat to eggs for their successful embryonic development, and in many species determine egg temperature during incubation. We investigated brood patch development of Magellanic Penguins *Spheniscus magellanicus* in Isla Quiroga, Argentina, during 2012–2013. Here, we evaluate if brood patch development (in a narrow sense i.e. increase of the brood patch area and temperature measured with an electronic probe thermometer) varies according to laying date of the eggs, and with respect to adults' body condition and size, total clutch volume, and/or the sex of the adults. We found that brood patch temperature reaches its maximum when egg laying is finished, while brood patch area is fully developed starting from the end of the first quarter of the incubation period. The later the penguins started to breed the warmer the initial brood patches — when first egg is laid. Besides, the incubation period was shorter in penguins breeding late. Furthermore, adults in a good body condition had cooler initial brood patches than adults with poor body condition. In contrast, total clutch volume, body size index, and sex of the adults were not related to brood patch development. We conclude that initial brood patch temperature in Magellanic Penguins is associated with environmental factors, like laying date, and physiological attributes, like body condition.

**Key words:** breeding biology, incubation, marine birds, brood patch area, brood patch temperature, penguin

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## INTRODUCTION

In birds, optimal incubation temperatures that cannot vary beyond a narrow range are needed for the correct development of the embryo (Webb 1987, Farmer 2000). The vast majority of birds achieve a successful incubation of their eggs through the exchange of heat between the abdominal brood patch and the eggs (Lea & Klandorf 2002). The brood patch is a de-feathered area, usually located in the ventral plane of the bird (Lea & Klandorf 2002) and is under direct hormonal control (Jones 1971), regulated by prolactin and steroid hormones (Lea & Klandorf 2002).

Brood patch development includes in a broad sense histological aspects (vascularization, epidermal hyperplasia, edema), but in many studies, brood patch development refers in a narrow sense only to the increase of the brood patch area and temperature (St. Clair 1992, Massaro et al. 2006). The development and characteristics of brood patches vary among species with different life history traits (Lea & Klandorf 2002). This variation makes it interesting to study, particularly, in species with different behaviors and breeding in different environments. Furthermore, in cold environments the correct development of the brood patch is essential to maintain the eggs at the right temperature under these harsh conditions. The brood patch can be influenced by a variety of environmental and ecological factors (Lea & Klandorf 2002). Factors affecting brood patch development, in a narrow sense i.e. increase of the brood patch area and temperature, include: (1) environmental factors like laying date (Massaro et al. 2006), (2) physiological constraints such as physical condition of the parents (Jónsson et al. 2006), (3) life history traits that can affect and determine the optimal brood patch temperature,

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# Does the song of the Wren *Troglodytes troglodytes* change with different environmental sounds?

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**Colino-Rabanal V. J., Mendes S., Peris S. J., Pescador M. 2016. Does the song of the Wren *Troglodytes troglodytes* change with different environmental sounds? Acta Ornithol. 51: 13–22.** DOI 10.3161/00016454AO2016.51.1.002

**Abstract.** Birds inhabiting urban areas have to deal with high levels of ambient noise. Some species show a certain song flexibility that enables them to reduce noise interferences in their communications. This vocal adjustment usually implies an increase in the minimum frequencies of songs. Since urban noise is mainly made up of low frequencies (about 2.5–3.5 kHz), song of species that sing at higher frequencies could be less susceptible to being masked by anthropogenic noise. This study explores whether such species also show any kind of adjustment to noisy environments. For this purpose, the spectral and temporal parameters (note duration, maximum and minimum frequency and diversity) of the song of the European Wren *Troglodytes troglodytes* were analysed in three different environments (urban, peri-urban and rural). To evaluate the impact of noise on the vocalizations, a specific acoustic descriptor of song variability was developed. Song variability increased along the urban noise gradient from rural to urban areas and the duration of notes decreased from rural to urban zones. Urban wrens developed more complex songs with higher frequencies and longer notes than their rural counterparts, whereas peri-urban birds occupied an intermediate position, although closer to urban ones in the length of notes. These changes could be associated with higher background noise levels, although other possible causes, such as the population density, could also explain them. Maximum frequencies were mostly outside the background noise range and differed among habitats, whereas lower frequencies unexpectedly did not differ among habitats. Our results suggest that differences in song parameters among species may lead to different mechanisms of vocal adjustment. Even in wrens, with high frequency vocalisation, interference with urban anthropogenic noise could show certain changes in their vocalizations.

**Key words:** song variability, acoustic pollution, speech interference level, urban noise gradient, vocal adjustment, Wren

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## INTRODUCTION

The expansion of cities implies increasing acoustic pollution, which is a new potential threat to bird species that inhabit them and use acoustic communication in territorial defence and mate attraction. Since most bird species depend on acoustic signals for their biological cycle, birds may be affected in noisy areas (Ortega 2012). The alterations generated in the acoustic field of such habitats may mask different sound spectra, affecting animal communication (Western 2001, Brumm & Slabbekoorn 2005, Warren et al. 2006). If vocalisations are not heard or deciphered properly, birds may change their territorial limits, become more exposed to predators, and reproduce less successfully (Klump 1996, Marzluff et al. 2001, Halfwerk et al. 2011). Some species living along highways became less abundant or even disappeared, which was attributed mainly to anthropogenic noise (Van der Zande et al. 1980, Brotons & Herrando 2001, Peris & Pescador 2004, Parris & Schneider 2009) and road mortality (Summers et al. 2011). Since species' tolerance to ambient noise differs, some species avoid noisy areas, whereas other adapt through changes in their song components, vocal amplitude and call frequency. In other words, anthropogenic noise could affect some bird species more than others, altering avian communities and interactions among species (Francis et al. 2009).

Some species inhabiting urban areas develop changes in their songs and calls, mainly in higher power spectrum, note duration, and

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# Extreme landscapes decrease taxonomic and functional bird diversity but promote the presence of rare species

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**Godet L., Devictor V., Burel F., Robin J.-G., Ménanteau L., Fournier J. 2016. Extreme landscapes decrease taxonomic and functional bird diversity but promote the presence of rare species. Acta Ornithol. 51: 23–38.** DOI 10.3161/00016454AO2016.51.1.003

**Abstract.** Human activities may generate geometrical landscape (i.e. composed of rectilinear and repetitive landscape units) structures that can significantly influence the spatial distribution of birds. While bird distribution in various landscape types has been extensively studied, the role played by landscape configuration and composition in different facets of bird diversity remains unclear. Here, these two main components of landscape characteristics (i.e. configuration and composition) are disentangled and their relative influence on three different facets of bird assemblages: taxonomic and functional characteristics, and the presence of rare species, is tested. We chose four large coastal salinas of Western France as a relevant model of geometrical and human-dominated landscapes where each landscape unit can be easily identified and mapped. The landscape characteristics of these sites were mapped and quantified. Then, terrestrial breeding birds were sampled in 172 point-counts using a standardized protocol. 69 diurnal terrestrial bird species were detected and considered in analyses (waterbirds and owls excluded). Landscape composition was found to have a higher influence on bird communities than landscape configuration, which fits with the "landscape composition hypothesis". More specifically, the most "extreme" landscapes — those with low terrestrial surface areas, low landscape richness and diversity, low cohesion, and very patchy landscapes with complex geometrical shapes — host the lowest bird taxonomic abundance, richness and diversity and functional richness, but are characterized by the presence of rare species (mainly wetland specialist species, e.g. Reed Bunting *Emberiza schoeniclus* and species with restricted ranges e.g. Bluethroat *Luscinia svecica namnetum*). Our results suggest that conservation plans in such geometrical and human-dominated habitats should not only focus on one aspect of landscape characteristics or one aspect of biological diversity but also consider the adverse effects of landscape characteristics on these different facets.

**Key words:** fragmentation, landscape, songbirds, passerines, salinas, taxonomic diversity, functional diversity, species rarity, landscape configuration, landscape composition

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## INTRODUCTION

The influence of landscape characteristics on birds has been intensively investigated in terrestrial ecosystems, particularly in forests (see Forman et al. 1976 for a seminal article on the subject, or Cushman & McGarigal 2002 for a more recent study in North America) and hedgerow networks (reviewed by Hinsley & Bellamy 1999). However, it is often difficult to compare and synthesize these results, mainly because of the plethora of different landscape indices used, corresponding to different components of landscape characteristics. One of the challenges, therefore, is to distinguish clearly the different components of landscape characteristics in order to test their relative influences.

A first and rather intuitive way of classifying landscape characteristics is to differentiate landscape features related to fragmentation (the subdivision of a habitat into several patches and the size of a patch), connectivity (the number of links — or corridors — between patches) and heterogeneity (the diversity of different habitats and the

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# Partial migration in a Central European raptor species: an analysis of ring re-encounter data of Common Kestrels *Falco tinnunculus*

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**Holte D., Köppen U., Schmitz-Ornés A. 2016. Partial migration in a Central European raptor species: an analysis of ring re-encounter data of Common Kestrels *Falco tinnunculus*. Acta Ornithol. 51: 39–54.** DOI 10.3161/00016454AO2016.51.1.004

**Abstract.** In partially migratory bird species, some individuals of a population migrate while others stay in the breeding area. Although Common Kestrels *Falco tinnunculus* are defined as partial migrants, their migratory strategies are still not well described. We investigated ringing and re-encounter data of Kestrels marked as nestlings between 1924 and 2011 in Germany. We defined four populations corresponding to the natural regions of Germany. Although both migratory and resident individuals were found independently of sex or age class at the time of recovery, in general, females and juveniles travelled larger distances than males and adults, respectively. We illustrated the initiation of migratory movements in contrast to dispersal by combining distances and directions in two levels (< 100 km and ≥ 100 km), showing that migration is initiated mostly in September/October, while in August movements seem to mostly reflect dispersal. The NAO Index as well as age class, region and re-encounter period (1950–1970, 1971–1990 or > 1990 as indicator of responses to climate change) of birds in autumn and winter were integrated into Generalized Linear Models. We found that in autumn and winter a tendency to migrate is primarily shown by juveniles and it was significantly higher in years before 1971 than in recent decades. In addition, a higher NAO Index in summer is linked with decreased proportion of birds re-encountered far (> 100 km) from their natal sites in winter, whereas a higher NAO Index in autumn is linked with increased proportion of high-distance re-encounters (> 100 km).

**Key words:** partial migration, ring recovery, ring re-encounter, Common Kestrel, *Falco tinnunculus*, differential migration, climate change, NAO Index

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## INTRODUCTION

Avian migration is a widespread phenomenon occurring as a response to seasonal variations, which are often associated with changes in climatic conditions and, consequently, the availability of food. Thus, species must adapt to these variations or move to more favourable regions where their chances to survive and reproduce successfully are higher (Berthold 2007, Newton 2008). Avian migratory strategies are various and do not only differ among species, but in some cases among populations or even among individuals within a population like in the case of "differential migration". Here, often migration times or routes differ among sexes and/or age classes (e.g. Kjellen 1994, Cristol et al. 1999, Newton 2008). Dierschke et al. (2005), for instance, found that in Northern Wheatears *Oenanthe oenanthe*, males migrate earlier than females during spring migration. In European Ospreys *Pandion haliaetus*, adult females leave the breeding sites in autumn earlier than adult males which winter closer to the breeding sites than females and juveniles, likely in order to get early access to breeding territories (Bai & Schmidt 2012).

Moreover, "partial migration" implies that, within a population, some individuals migrate, while others stay in or near their breeding area (e.g. Newton 2008, Chapman et al. 2011, Pulido 2011). This kind of migration is common in many bird species, ranging, for instance, from small songbirds through waterbirds (e.g. Meller et al. 2016) to raptors and falcons (see Bauer et al. 2005).

Migratory strategies are subject to a multiplicity of external drivers, such as social influences

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# Analysis of ring recoveries of European Turtle Doves *Streptopelia turtur* — flyways, migration timing and origin areas of hunted birds

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**Marx M., Korner-Nievergelt F., Quillfeldt P. 2016. Analysis of ring recoveries of European Turtle Doves *Streptopelia turtur* — flyways, migration timing and origin areas of hunted birds. Acta Ornithol. 51: 55–70.** DOI 10.3161/00016454AO2016.51.1.005

**Abstract.** Knowledge about flyways, breeding and overwintering sites is important for conservation efforts, but little is known about migration patterns and population connectivity of declining European Turtle Doves *Streptopelia turtur*. EURING ring-recovery data were used to estimate directions and proportional usage of flyways. The timing of migration was compared along these routes and breeding origins of shot individuals were determined. Ring recoveries of Czech, Hungarian, British, German and French birds suggested three main flyways with westerly, central and easterly directions. The proportional usage was estimated by multinomial mark-recovery models. Major parts of French (62%), German (92%) and British (94%) Turtle Doves followed a western flyway. Czech birds used the central route (56%) and 55% of Hungarian birds followed the eastern flyway. Thus, a migratory divide between the Czech Republic and Germany could be suggested. The timing of migration showed a similar latitudinal pattern of migration along all flyways. Birds were at the breeding grounds in June and July and from September to April in their southernmost distribution ranges. Outward migration started in August. Return migration was still evident in May. The majority of reported hunted doves were from the 1960s and 1970s. High hunting numbers were present in September, April and May. France and Spain mainly shot birds from the UK and France. In Italy predominantly Italian birds were shot. Doves shot in Greece mostly came from the Czech Republic. Given the decreasing population numbers, large ringing numbers seem unlikely in the future. Thus, low recovery numbers in recent decades parallel both, the population decrease and a lower ringing activity.

**Key words:** Turtle Dove, *Streptopelia turtur*, EURING, multinomial model, flyways, timing of migration, hunting

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## INTRODUCTION

More than 2 billion European birds migrate twice a year to and from Africa (Hahn et al. 2009). To arrive at their destination points, they follow different migration strategies. Many of these birds follow broad front migration patterns (Zink 1973–1995, Berthold 2000). Further studies describe two main flyways in westerly and easterly directions over the Iberian Peninsula or along Middle East European land, which can be induced by a migratory divide (Zink 1973–1995, Berthold 2000, Reichlin et al. 2009).

When a breeding population winters together in one area, the migratory connectivity for this population is described as high (Webster et al. 2002). The degree of migratory connectivity sinks when large parts of one breeding population disperse to different wintering grounds (Webster et al. 2002).

The phenology of different species and bird populations is believed to be controlled by endogenous mechanisms. Thus, the start of migration is primarily regulated by genetic factors, but also triggered by circumannual rhythms, particularly changes in day length (Berthold 2000). Nonetheless, some studies showed an adjustment of migration patterns. Therefore, bird migration can also be flexible to a certain degree in some species (Marra et al. 2005).

European Turtle Doves *Streptopelia turtur* are the only long-distance migrants among European columbids that participate in trans-Saharan

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# Nesting preferences of Syrian Woodpeckers *Dendrocopos syriacus* in the agricultural landscape of SE Poland

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**Michalczuk J., Michalczuk M. 2016. Nesting preferences of Syrian Woodpeckers *Dendrocopos syriacus* in the agricultural landscape of SE Poland. Acta Ornithol. 51: 71–81.** DOI 10.3161/00016454AO2016.51.1.006

**Abstract.** The nesting preferences including both habitat and nest site characteristics of Syrian Woodpeckers in the agricultural landscape were assessed based on 69 nest sites described. Orchards were the preferred tree stand of the woodpecker, where 58% of its nests were located. The average diameter of tree in which the woodpeckers nested was much higher than the average trees available in territories (47.4 cm and 32.5 cm respectively). The condition of the nest trees was worse than the average trees present in the territories of the birds. Amongst Syrian Woodpecker nesting habitats, only orchards had a worse state of health compared to trees growing in groups, rows or forests. Apple trees *Malus domestica* with 43.5% of nest sites were also in worse health condition compared to willows *Salix* spp. (20.3% of nest sites), poplars *Populus* spp. and walnut trees *Juglans regia*. The average height of trees with nest holes was 11.3 m and the average height of nest hole placement was 4.2 m. The Syrian Woodpecker is an ecologically flexible species, but it requires trees with larger diameter trunks that are in poorer health as nest trees, such as, for example, apple trees or soft wood trees such as willows. The protection of non-forest tree stands dominated by these species and orchards, which are preferred by this bird, may be important to maintain the Syrian Woodpecker in the agricultural landscape.

**Key words:** nest-site selection, Syrian Woodpecker, *Dendrocopos syriacus*, habitat preferences, rural landscape, orchads

## INTRODUCTION

European species of the woodpecker genus *Dendrocopos* are mainly found in forests, even though they have very different habitat preferences (Winkler et al. 1995, Winkler & Christi 2002). The Syrian Woodpecker *Dendrocopos syriacus* occurs in quite different habitats, mainly colonizing anthropogenic woodlots and avoiding forest areas in Europe (Cramp 1985, Michalczuk & Michalczuk 2015, 2016c). It is also most frequently seen in various types of anthropogenic tree stands in Asia Minor, where the species originally inhabited thermophilic forest communities (Winkler 1973, Glutz von Blotzheim & Bauer 1980). These tree stands are mostly orchards, but also other habitats, such as, for example, surrounding housing estates, where fruit and ornamental trees predominate, in which the woodpecker often nests (Mendelssohn & Yom-Tov 1999, Hatzofe & Yom-Tov 2002, Al-Safadi 2004, Ar et al. 2004, Aghanajafizadeh et al. 2011). Nesting Syrian Woodpeckers also use such fruit trees as mulberry *Morus* spp. (Szlivka 1957, 1962) and Walnut *Juglans regia* (Ruge 1969) in the European agricultural landscape. In urban areas, the nests of this species were found mainly in Ashleaf Maples *Acer negundo* (Biaduń 2001) and willows *Salix* spp. (Fröhlich & Ciach 2013). However, the knowledge of nest-site preferences of this species is still insufficient, because the Syrian Woodpecker is still the least known European woodpecker species (Pasinelli 2006).

The Syrian Woodpecker's presence in non-forest tree stands is important for many other species of birds, because it provides this habitat with most of the holes used by secondary hole nesters (Szlivka 1957, 1962, Mitjaj 1986, Gorman 2004, Michalczuk et al. 2011, Michalczuk & Michalczuk 2016a). Despite the rapid expansion of this keystone species in Europe (Cramp 1985, Zavialov et al. 2008, Michalczuk 2014), in some areas, including Poland, the Syrian Woodpecker's population is currently decreasing (BirdLife International 2004, Michalczuk et al. 2011, Hristov & Petkov 2013, Michalczuk & Michalczuk 2015). This may

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# Multiple structural colors of the plumage reflect age, sex, and territory ownership in the Eurasian Magpie *Pica pica*

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**Nam H.-Y., Lee S.-I., Lee J., Choi C.-Y., Choe J. C. 2016. Multiple structural colors of the plumage reflect age, sex, and territory ownership in the Eurasian Magpie *Pica pica*. Acta Ornithol. 51: 83–92.** DOI 10.3161/00016454AO2016.51.1.007

**Abstract.** The role of structural coloration, which is produced by the optical interactions among micro- and nanostructures in the feather barb or barbules, is still unclear in the context of sexual or social signaling, because the mechanism of color production is complex and the factors affecting it are not fully documented. We investigated whether structural colors represent class signals related to age, sex, and territory ownership in a social, sexually monochromatic species, the Eurasian Magpie *Pica pica*. We examined the reflectance spectra from white scapulars, bluish iridescent secondary and greenish iridescent tail plumage, as well as size of white scapular patch. Significant color differences between age classes were found in all measured plumage parts, with adults having plumage with higher color score, that is brighter, shorter wavelength-directed, and more saturated color, than young magpies. Color differences between males and females and between breeding adults (territorial owners) and non-breeding adults were only detected in the tail plumage. Size of white scapular patch did not differ between age and sex classes. Color differences among individuals belonging to different social classes may lessen agonistic confrontations. Sex differences in coloration may enable prompt sex recognition and thus facilitate pair formation. Higher tail color scores of adults, particularly males, support previous suggestions that the tail characteristics of avian species with relatively long tails represent a visual signal of the bearer's quality.

**Key words:** structural coloration, iridescence, Eurasian Magpie, *Pica pica*, sexual dichromatism, class signal

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## INTRODUCTION

Plumage coloration in birds has long been investigated as an indicator of the bearer's quality with respect to social status (Rohwer 1975), parasitic resistance (Hamilton & Zuk 1982), territory quality (Hill 1988), or nutritional condition (Hill 1991). Plumage colors can be either pigment-based or structure-based. In contrast to a long history of investigation of the former, color producing mechanisms and ecological correlates of the latter are being rigorously investigated only recently after the use of ultraviolet- or violet vision was found in birds (Bennett et al. 1996, 1997, Andersson et al. 1998, Hunt et al. 1999, Banks 2001).

Structural color, which is produced by the optical interactions among micro- and nanostructures in the feather barb or barbules, can be classified into three categories (Prum 2006): unpigmented white, non-iridescent, and iridescent colors. Unlike white color that is produced by incoherent scattering of non-pigmented keratin, non-iridescent colors with UV-, violet-, and blue-ranged hues are usually produced by coherent scattering from spongy medullary layers of feather barbs with basal melanin layers (Shawkey & Hill 2006). Iridescent colors are mainly produced by coherent

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# Habitat structure of temporary settlement areas of young Saker Falcon *Falco cherrug* females during movements in Europe

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**Nemček V., Uhrin M., Chavko J., Deutschova L., Maderič B., Noga M. 2016. Habitat structure of temporary settlement areas of young Saker Falcon *Falco cherrug* females during movements in Europe. Acta Ornithol. 51: 93–103.** DOI 10.3161/00016454AO2016.51.1.008

**Abstract.** During 2008–2011, nine juvenile Saker Falcon *Falco cherrug* females were tagged with satellite transmitters in Slovakia. Satellite telemetry provided new insights into the juveniles' movements. In this study we present the use of temporary settlement areas (TSAs) during the movement of the tracked juveniles. We characterized natal areas (NAs, the first TSA in the life cycle of juvenile, restricted to the nest) and TSAs as areas where the distance between the all-night perches did not exceed ten kilometres and where a particular bird spent at least five consecutive days. In these areas 3 types of polygons were identified in relationship to the area of use — a home range (95% kernel polygons), a core area (50% kernel polygons) and an overall used area (100% minimum convex polygons). The overall used areas were highly variable and probably influenced by exploratory flights, when sakers fly out of their home ranges and come back at night. Habitat preference was then analysed in the TSAs for a better understand of juvenile habitat requirements. For habitat preference a CORINE raster image (version 13/2006) with a resolution of 100 × 100 m was used. In the TSAs 14 habitat categories were recorded, but for statistical analysis only 8 habitat categories were used. Conservation status of the NAs and TSAs was also described. Arable land represented the dominant habitat category in the TSAs (mean 67.64% for overall used areas, and 80.94% for core areas). A significant difference was found in the habitat structure of the overall used areas, the home ranges and the core areas. All of the tracked Saker Falcons preferred arable land, while avoiding two habitat categories — forests and scrub and/or herbaceous vegetation associations. The number of days spent in the TSAs (9–139 days, mean = 46.7 days) and in the NAs (36–134 days, mean = 62.3 days) varied by different individuals. Most of the NAs and TSAs are at least partially covered by protected areas, only four areas had no conservation status.

**Key words:** diurnal raptors, Falconiformes, stopover sites, wintering sites, raptor migration, landscape structure, Platform Transmitter Terminal, satellite telemetry, spatial ecology

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## INTRODUCTION

From the point of view of conservation ecology a very important period in bird life cycle is the period after fledgling, which is especially worthy of interest in migratory species. Development of satellite tracking has enabled new data to be recorded about the movement of birds. Satellite telemetry has recently brought a new approach and promising results to the study of the migration, movement and spatial ecology of raptors (Liminana et al. 2007, Cadahía et al. 2010, García-Ripollés et al. 2011, Mellone et al. 2012), including the ecology of birds of prey during stays in temporary settlement areas (TSAs).

The use of TSAs is a common survival strategy (Ferrer 1993, Soutullo et al. 2008, del Mar Delgado et al. 2009, Mellone et al. 2011, Prommer et al. 2012). Temporary settlement areas represent an area occupied during dispersal. Individuals become more familiar with their environment and they learn what significant habitat features exist in the area due to the increasing time spent in the settlement area (Stamps & Krishnan 1999). The strategy — how TSAs are used — is employed differently by particular species of raptors. In Spain juvenile Bonelli's Eagles *Hieraaetus fasciatus* and Spanish Imperial Eagles *Aquila adalberti* restrict most of their movements to a few sites within the boundaries of their dispersal areas. These are used

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# Selection of plants for sap feeding by the White-fronted Woodpecker *Melanerpes cactorum* in Chaco dry forest, Argentina

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**Abstract.** Woodpeckers feed primarily on insects, larvae and other arthropods; however, several members of this family include plant products in their diets, such as sap. Among them, the genera *Sphyrapicus* and *Melanerpes* include the most species that specialize in sap consumption. In semiarid forests of Argentina, sap is an important food item in the diet of the White-fronted Woodpecker, *Melanerpes cactorum*. The aim of this study is to investigate why White-fronted Woodpeckers only consume sap from certain plants while avoiding other available plants of the same species and explore seasonality of their plant selection. We expected that combinations of plant traits (i.e. sugars concentration of sap, sap flow intensity, plant size, plant health and plant microhabitat), rather than one particular trait, determine which tree they select for sap feeding in different seasons. We examined five plant species: *Sarcotoxicum salicifolium*, *Prosopis ruscifolia*, *Ziziphus mistol*, *Aspidosperma quebracho-blanco* and *Stetsonia coryne* that were used most frequently for sap consumption and were consumed in all seasons by ten groups of White-fronted Woodpecker in semiarid Chaco, Argentina. Plants selected by White-fronted Woodpeckers for sap consumption were mainly larger plants that yield high sugar concentration. Of the plant species we studied, individual plant selection in all seasons was more evident in those plant species that constitute an important part of their diet (i.e. *Prosopis ruscifolia* and *Stetsonia coryne*). The selection of plants offering a greater reward in sap quality strongly suggests that the White-fronted Woodpecker maximizes food energy intake as a response to the seasonality that characterizes semiarid climates of temperate regions and conditions of food resources availability. Our results show that large trees are selected as sap trees by White-fronted Woodpecker, therefore, we recommend activities that promote retention of large trees in Chaco region.

**Key words:** *Melanerpes cactorum*, sap-trees, sap traits, sap feeding, foraging, semiarid Chaco, woodpeckers

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## INTRODUCTION

Phloem sap is nutrient rich compared to many other plant products, with high concentrations of sugars that provide an abundant source of carbon, energy, and nitrogen, predominantly in the form of free amino acids (Taiz & Zeiger 2002). Although phloem sap is an excellent diet resource for animals, it is consumed as the dominant or sole diet by a restricted range of animals (Douglas 2006). Among vertebrates, certain species of birds (e.g. woodpeckers, parrots, honeycreepers) and mammals (e.g. marsupials, squirrels, primates) are able to overcome plant defences and exploit this resource by choosing specific plant species and individuals within species, which they use during certain seasons of the year (Snyder 1992, Eberhardt 2000, Pejchar & Jeffrey 2004, Thompson et al. 2013, Charles & Linklater 2014, Wallis & Goldingay 2014).

The literature suggests that animals do not choose a random sample of trees for sap feeding. Sap-tree selection by vertebrates probably reflects the need of a balance between nutrient acquisition and avoidance of deleterious compounds, and can be based on particular characteristics of plant species as well as of individual plants (Snyder 1992). Factors determining sap-tree selection remain poorly understood and there is little consensus between studies, although previous research on sap-feeding species suggests that multiple variables affect tree choice (Goldingay 1987).

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# Coal Tits *Periparus ater* build larger nests than Blue Tits *Cyanistes caeruleus* and Great Tits *Parus major* living in the same Mediterranean coniferous woodland habitat

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**Abstract.** The size and shape of the nest are species-specific characteristics that are often associated with environmental factors at the time of breeding. Nests are expected to be larger or thicker in colder environments, although the relationships between nest design and weather differ between species. Here we present the results of an analysis of the external height of the nest wall in Paridae that accepted small standardized nesting boxes for breeding. The study populations were monitored in a relatively cold Mediterranean study area. We found that Coal Tits *Periparus ater* built higher external nest walls than Great Tits *Parus major* or Blue Tits *Cyanistes caeruleus*, after controlling for the first-egg date and clutch size which are assumed to reflect aspects of the quality of the nest builders. Our measures of nest size were not closely associated with the average ambient temperature, but nest walls tended to be shallower when there was more rain. Nest-shape asymmetry, as reflected in the difference in the external height of the nest measured closest to and farthest from the nest-chamber entrance, was observed in all three species, but the average asymmetry was highest in Coal Tits. In asymmetric nests, more nest material was added to the side that was closest to the front wall considered to be the coldest and least protected against harsh weather. Thus, nest size characteristics differ between three ecologically similar species inhabiting the same cavity type in the same coniferous woodland habitat, which would imply that different species do not respond in the same way to the same set of environmental factors.

**Key words:** Coal Tit, Great Tit, Blue Tit, nest size, nestboxes, hole-nesting birds

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The size and shape of the nest are species-specific characteristics and are often associated with environmental factors expressed before the onset of egg-laying. Because breeding is assumed to be energy-expensive, breeders are expected to evolve reproductive strategies that minimize energy loss (e.g. Lack 1968). For instance, to minimize heat loss in cold environments, avian nests are expected to be thicker, and thus more insulated than in milder environments (Slagsvold 1989, Soler et al. 1998, Hansell 2000, Schaedelin & Taborsky 2009, Mainwaring et al. 2014, Møller et al. 2014). Breeders are therefore expected to build larger, more insulated nests at more northern latitudes, at higher altitudes, during colder years or earlier in the season. For instance, nests are expected only to be thicker and thus better insulated earlier in the season than nests built later in the season for those species inhabiting temperate environments in the northern hemisphere (e.g. Skowron & Kern 1980, Nager & van Noordwijk 1992, Britt & Deeming 2011, Deeming et al. 2012, Mainwaring et al. 2012). However, several species that are exposed to harsh or cold weather (e.g. seabirds,

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# A simple and reliable medium-throughput method to measure relative telomere length in Sand Martins *Riparia riparia*

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**Abstract.** The rate of telomere loss is increasingly being used as a marker of biological aging, organismal senescence, and survival probability. These protective ends of chromosomes act to protect coding DNA during replication and by buffering against degradation from reactive oxygen species (ROS). In many organisms, telomere loss has been linked to increased levels of metabolism, biological stress and disease. Here we validate a medium-throughput and reliable method to measure relative telomere length in Sand Martins *Riparia riparia*. We performed the qPCR assay on a population of variously aged individuals from eastern Hungary. We detected a significant negative relationship between relative telomere length and age and observed a clear drop in telomere length in older age classes (> 4 years) but no relationship with gender or body mass. Our results in this cross-sectional study support findings in other passerine species that report a lack of long telomeres in older individuals. The method that we describe will allow longitudinal studies of Sand Martin individuals in wild populations to track telomere dynamics related to various life history characteristics and individual health.

**Key words:** senescence, telomeres, qPCR, *Riparia riparia*, age

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Variation in telomere length and its rate of loss are closely associated with individual differences in rates of aging, survival probabilities and health (Monaghan & Haussmann 2006). Telomeres are specialised protein-DNA complexes that act as “caps” on the ends of chromosomes to prevent chromosomal degradation and end-to-end fusions (Blackburn 1991, von Zglinicki 2002). Due to the “end replication problem” (shortening of chromosomes during replication due to the insertion of RNA primers for the synthesis of Okazaki fragments on the lagging strand), telomeres have been shown to shorten with every cell division. Once a critical threshold is reached, cell replicative senescence is initiated and the cells irreversibly lose the potential to divide (Blackburn 1991, Blasco 2007). Further studies have indicated that rates of telomere loss are also associated with exposure to chronic stress and lifestyle factors particularly during early development (Aydinonat et al. 2014). While telomere shortening and associated cellular senescence provides a mechanism to eliminate cells with DNA damage and protect against cancer, it also impairs cell function and contributes to organismal ageing and mortality (Monaghan & Haussmann 2006).

Studies investigating telomere length and rates of attrition can be highly informative and reveal important associations with life history traits and individual fitness. In birds, short telomeres have been linked to reduced survival probability in one-year old Tree Swallows *Tachycineta bicolor* (Haussmann et al. 2005) and, together with the rate of telomere loss, have been shown to be a better predictor of longevity than age in Alpine Swifts *Apus melba* (Bize et al. 2009) and Jackdaws *Corvus monedula* (Salomons et al. 2009). In Jackdaws it was also shown that telomere shortening is associated with developmental suppression, which in turn affects survival probability and longevity (Boonekamp et al. 2014). A link has also been demonstrated between nutrition and rates of