

Seasonal variation in bird species richness and abundance in riparian galleries in Southern Portugal

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Abstract. Riparian ecosystems are critical in maintaining biodiversity on a regional scale, which is particularly important for open agroforestry systems. We evaluated bird species richness and abundance in three different distances from the stream (0, 125 and 250 m) in Cork and Holm Oak forest systems (Montado) in southern Portugal. We used 5-minute point-counts to survey birds in two daily periods (morning and afternoon) of three different seasons (breeding season, summer-autumn migration and winter), to describe seasonal and daily variations in the use of riparian galleries and adjacent areas by birds. To assess whether birds move actively from the surrounding matrix into the riparian gallery, we installed mist-nets in mid-summer, autumn migration and winter periods, in two sites adjacent to streams, and recorded flight direction of all passerines trapped in the mist-nets. Both species richness and bird abundance were significantly higher in the riparian gallery than in the adjacent matrix. Species richness was significantly higher during the summer-autumn migration period, and bird abundance significantly lower during the breeding season. Apart from the Short-toed Treecreeper *Certhia brachydactyla*, Nuthatch *Sitta europaea* and Chaffinch *Fringilla coelebs*, all other species (e.g. Blackbird *Turdus merula* and Sardinian Warbler *Sylvia melanocephala*) were generally more abundant closer to the stream than at 250 m away. A significantly higher percentage of birds moved from the surrounding matrix into the riparian gallery in mid-summer, but not during the autumn migration and winter, which suggests that microclimatic conditions are important to explain observed seasonal differences. This study shows the importance of considering seasonal variation for the management of passerine bird populations in riparian galleries of Mediterranean areas. A well conserved riparian gallery appears to be a keystone structure exerting a strong influence on the number of bird species associated with surrounding agro-forestry systems such as the Montado.

Key words: riparian gallery, surrounding matrix, passerines, census, montado, summer, winter, seasonal variation

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INTRODUCTION

Riparian areas are described as the land adjacent to streams, rivers, and nearshore environments that interact with aquatic environments (Naiman & Decamps 1997, Ferreira et al. 2005). Riparian galleries present greater heterogeneity, have relatively high biodiversity, provide critical habitat for rare and threatened species, are refuge and resource areas for prey and predators, and can act as corridors for migrating species (Naiman et al. 1988, Risser 1990). The importance of riparian galleries for the functioning of ecosystems is particularly relevant for relatively dry areas such as savannah-type habitats of the Mediterranean

region. In arid regions in particular, riparian ecosystems are critical in maintaining high biodiversity on a regional scale (Johnson et al. 1977, Rottenborn 1999, Godinho et al. 2010). This is noticeable when riparian galleries provide the only breeding and feeding forest habitat in otherwise open landscapes (e.g. Deschênes et al. 2003, Pereira et al. 2014). Bird species richness in Mediterranean riparian galleries varies throughout the year as a result of seasonal habitat changes, and particularly due to the influx of migrating and wintering birds. For example, during autumn migration both resident and migrant birds are present at higher numbers in the Iberian Peninsula, particularly along riparian galleries (Pereira et al. 2014).

However, few studies have so far described the importance of riparian galleries vs. the surrounding matrix, taking into account seasonal variations in bird species diversity (e.g. Leal et al. 2011). In Mediterranean-type ecosystems the vegetation cover and habitat heterogeneity is usually higher for riparian galleries than for the surrounding matrix, which leads to greater avian species richness in riparian galleries (Bub et al. 2004). The higher vegetation cover of riparian galleries provides more shade and wet conditions, and thus greater microclimatic stability for fauna than adjacent areas, but this prediction has rarely been addressed (Bub et al. 2004). Thermal variation between riparian galleries and the surrounding matrix is markedly different (Brosfokske 1996) and linked to light intensity, as understory light tends to be highest at the riparian forest edge, but decreases rapidly towards the riparian forest interior (MacDougall & Kellman 1992). This thermal variation should favour the movement of birds from the surrounding matrix into the riparian gallery, particularly during the hot summer months and especially in the afternoon when the thermal variation should be even more markedly different. Overall, the role of microclimatic conditions to explain seasonal differences in bird diversity between riparian areas and the surrounding matrix has not been considered explicitly. This is likely to be of particular importance for resident and migrating songbirds during the summer hot periods, and for wintering and resident passerines during the cold season. In this study we examined the seasonal variation in songbird species richness and diversity in the riparian gallery and in the adjacent matrix, to answer the following questions: 1) How important are the riparian galleries vs. adjacent areas for songbirds? 2) Does this importance vary throughout the year? 3) Does the abundance of each species vary between the morning and the afternoon? 4) Do birds show active seasonal movements from the surrounding matrix into the riparian gallery and vice versa? Results are discussed taking into consideration the empirical microclimate conditions and food resources of the riparian gallery and the surrounding matrix.

MATERIALS AND METHODS

Study area

Bird surveys were conducted in 2013 and 2014 on 30 sites of riparian corridors and adjacent matrix

located in an approximated 34 km radius around the city of Évora (Évora, Montemor-o-Novo, Redondo and Arraiolos municipalities), Central Alentejo, Portugal. All sites were selected to present a relatively similar habitat structure in terms of vegetation and stream width. The climate is Mediterranean with an annual rainfall that varies between 500–800 mm (Instituto do Ambiente 1999). Average temperature varies from 9 °C in January to 24 °C in July, with daily mean temperature records ranging from 7 °C to 43 °C, and annual insolation ranging from 2900 to 3000 h/year (Instituto do Ambiente 1999). Altitude ranges from 200 to 300 m a.s.l. (Instituto do Ambiente 1999). Cork Oak *Quercus suber* and Holm Oak *Q. rotundifolia* agro-forestry systems, locally known as 'montados', are the dominant element of the landscape. Our riparian areas were dominated by blackberries *Rubus* spp., Narrow-leaved Ash *Fraxinus angustifolia* and willows *Salix* spp., and the dominant vegetation of our adjacent matrix areas were Holm and Cork Oaks with a shrub layer of rockroses (*Cistus crispus*, *Cistus salvifolius* and *Cistus ladanifer*) and thistles *Cynara* spp.. All the riparian galleries sampled had relatively similar stream width, ranging from 5 to 10 m with a torrential character.

Sampling sites and bird surveys

We evaluated bird communities in each of the 30 sampling units (stretches of streams) in watercourses from the Tejo, Sado and Guadiana basins. In all sampling units the surrounding matrix of 'montado' was relatively similar in terms of arboreal and shrub percentage cover, with ca. 30 mature trees/ha. In each unit we followed the procedure used by Pereira et al. (2014) and sampled one point in the riparian gallery (P1) followed by two points in the surrounding matrix: P2, 125 m perpendicular from P1 and P3, 250 m from P1, thus comprising 90 sampling points. We used fixed 5 min point-count stations (Fleishman et al. 2003) and counted birds, located visually and by sound, within a 50 m radius for point-counts located in the matrix (P2 and P3), and within a band of 100 m length × 25 m width (including both sides of the stream) in the riparian gallery, due to its linear structure. To better visualize differences in bird composition among the three points, we represented graphically the seasonal variation in species richness and bird density within the area surveyed for each point P1, P2 and P3. All sites were surveyed during the breeding season (from 6 May to 8 June 2013), summer-